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PILOT WATERSHED STUDY
SOIL AND WATER ENVIRONMENTAL ENHANCEMENT PROGRAM

REPORT #5: EVALUATION OF CONSERVATION SYSTEMS, HYDROLOGY

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TABLE OF CONTENTS

		Page
EXECUTIVE SUMMARY		
1.0	INTRODUCTION	1.1
1.1	Background	1.1
1.2	Objectives of the Pilot Watershed Study	1.3
1.3	Report Structure	1.5
1.4	Specific Objectives	1.5
2.0	MONITORING INSTALLATIONS AND METHODS	2.1
2.1	Watershed Outlets	2.1
2.2	Microbasins	2.3
2.3	Rainfall Simulator	2.4
2.4	Groundwater	2.6
3.0	OBSERVATIONS AND EVALUATION	3.1
3.1	Watershed Scale	3.1
3.1.1	General Observations	3.1
3.1.2	Hydraulic Yields	3.4
3.1.3	Effects of Cover on Runoff	3.7
3.2	Microbasins	3.10
3.2.1	Background	3.10
3.2.2	Microbasin Runoff	3.10
3.2.3	Effects of Cover Upon Runoff	3.12
3.3	Rainfall Simulation	3.14
3.3.1	General	3.14
3.4	Groundwater	3.24
3.5	Soil Moisture	3.25

PRINTED ON RECYCLED PAPER

		Page
4.0	DISCUSSION AND CONCLUSIONS	4.1
4.1	Discussion	4.1
4.1.1	Watershed Scale	4.1
4.1.2	Microbasins	4.1
4.1.3	Rainfall Simulation Scale	4.2
4.2	Conclusions	4.3
5.0	REFERENCES	5.1

APPENDIX A: Watershed Scale Hydrologic Data

APPENDIX B: Microbasin Scale Hydrologic Data

APPENDIX C: Rainfall Simulation Data

APPENDIX D: Groundwater and Soil Moisture

PRINTED ON RECYCLED PAPER

LIST OF TABLES

Table 2.1: Schedule of Environmental Monitoring Station Installations (1988 to 1992)

Table 2.2: Physical Microbasin Characteristics

Table 2.3: Microbasin Flow Monitoring Installations

Table 2.4: Time and Field Conditions of Rainfall Simulation Runs

Table 3.1: Streamflow Summary (January 1989 to June 1992) Essex Sub-watershed Main Outlets

Table 3.2: Streamflow Summary (January 1989 to June 1992) Kettle Creek Sub-watershed Main Outlets

Table 3.3: Streamflow Summary (January 1989 to June 1992) Pittock Sub-watershed Main Outlets

Table 3.4: Essex Sub-watershed Hydraulic Yields

Table 3.5: Kettle Creek Sub-watershed Hydraulic Yields

Table 3.6: Pittock Sub-watershed Hydraulic Yields

Table 3.7: Generalized PWS Cover Patterns by Month and Crop-Tillage System

Table 3.8: Watershed Scale Average Cover by Season

Table 3.9: Number of Microbasin Events by Year

Table 3.10: Selected Essex Microbasin Events

Table 3.11: Selected Kettle Creek Microbasin Events

Table 3.12: Selected Pittock Microbasin Events

Table 3.13: Characteristics of Rainfall Simulation Sites

Table 3.14: Monthly Average Depth to Groundwater: 1989

Table 3.15: Monthly Average Depth to Groundwater: 1990

Table 3.16: Monthly Average Depth to Groundwater: 1991

Table 3.17: Monthly Average Depth to Groundwater: 1992

PRINTED ON RECYCLED PAPER

LIST OF FIGURES

Figure 1.1: SWEEP Organization Structure

Figure 1.2: SWEEP PWS Watersheds in Southern Ontario

Figure 2.1: Essex Environmental Monitoring Sites

Figure 2.2: Kettle Creek Environmental Monitoring Sites

Figure 2.3: Pittock Environmental Monitoring Sites

Figure 2.4: Essex Test Sub-Watershed Piezometer/Soil Moisture Monitoring Locations

Figure 2.5: Essex Control Sub-Watershed Piezometer/Soil Moisture Monitoring Locations

Figure 2.6: Kettle Creek Test Sub-Watershed Piezometer/Soil Moisture Monitoring Locations

Figure 2.7: Kettle Creek Control Sub-Watershed Piezometer/Soil Moisture Monitoring Locations

Figure 2.8: Pittock Test Sub-Watershed Piezometer/Soil Moisture Monitoring Locations

Figure 2.9: Pittock Control Sub-Watershed Piezometer/Soil Moisture Monitoring Locations

Figure 3.1: Essex Seasonal Streamflow: 1989-1992

Figure 3.2: Kettle Creek Seasonal Streamflow: 1989-1992

Figure 3.3: Pittock Seasonal Streamflow: 1989-1992

Figure 3.4: Essex Streamflow (1989-92)

Figure 3.5: Kettle Creek Streamflow (1989-92)

Figure 3.6: Pittock Streamflow (1989-92)

Figure 3.7: Essex Flow Distribution

Figure 3.8: Kettle Creek Flow Distribution

Figure 3.9: Pittock Flow Distribution

Figure 3.10: Ratio of Test and Control Flow (TQ/CQ) vs. Cover (TC/CC), Essex

Figure 3.11: Ratio of Test and Control Flow (TQ/CQ) vs. Cover (TC/CC), Kettle Creek

Figure 3.12: Ratio of Test and Control Flow (TQ/CQ) vs. Cover (TC/CC), Pittock

Figure 3.13: Rainfall Simulation - Essex Average Time to Ponding by Season

PRINTED ON RECYCLED PAPER

Figure 3.14: Rainfall Simulation - Kettle Average Time to Ponding by Season
Figure 3.15: Rainfall Simulation - Pittock Average Time to Ponding by Season
Figure 3.16: Rainfall Simulation - Essex Average Time to Runoff by Season
Figure 3.17: Rainfall Simulation - Kettle Average Time to Runoff by Season
Figure 3.18: Rainfall Simulation - Pittock Average Time to Runoff by Season
Figure 3.19: Rainfall Simulation - Essex Average Runoff by Season
Figure 3.20: Rainfall Simulation - Kettle Average Runoff by Season
Figure 3.21: Rainfall Simulation - Pittock Average Runoff by Season
Figure 3.22: Rainfall Simulation Summary - Total Runoff

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SWEEP PWS REPORT #5 EVALUATION OF CONSERVATION SYSTEMS, HYDROLOGY
EXECUTIVE SUMMARY

BACKGROUND

The Pilot Watershed Study (PWS), a major component of the Soil and Water Environmental Enhancement Program (SWEEP), was aimed at assessing and demonstrating the benefits of conservation farm management systems at the watershed scale. Planning and design of the PWS was completed in 1987 and environmental monitoring and evaluation was conducted from 1988 to 1992 at three paired watersheds within the Lake Erie drainage basin. During that time, there was intensive and continuous monitoring of hydrology and water quality at the plot, field and watershed scales. Detailed soil surveys and assessments of soil quality were also conducted along with monitoring of meteorology and agricultural productivity.

A main feature of the PWS was direct comparison of **test** (conservation oriented systems) and **control** (conventional systems) to determine the influence of conservation farm management on aspects of soil and water quality, including hydrology. The paired **test** and **control** watersheds were as similar with respect to physiography, hydrology, and farming systems. Baseline conditions for hydrology, soil and water quality, and crop yields were established at the onset of the study. Monitoring of water and soil related parameters at the microbasin level and the use of small scale rainfall simulation also allowed comparison of **test** and **control** conditions at the field and plot scale.

The PWS water quality assessment component was initiated as a mechanism to define the effects various soil conservation systems had on in-stream water quality at three scales of monitoring and evaluation: plot scale (1 m^2), microbasin scale (small watershed scale - 5 - 40 ha) and watershed scale (~400 ha). A **test** (conservation farm systems implemented) and **control** (conventional farm systems) paired watershed approach was used in this study within three distinct geographic areas of Southwestern Ontario: Pittock area north of Woodstock; Kettle Creek area south of London; and Essex just east of Windsor, Ontario.

The purpose of the of the hydrology component of PWS was to monitor runoff and stream flow to determine if the implementation of conservation farm systems had an affect on the overall basin hydrology. The specific objectives relating to the hydrology component of the PWS are:

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- through environmental monitoring, establish continuous records of watershed water balance in order to investigate hydrologic process;

- determine the flow component of runoff necessary for estimating mass flux of water quality parameters; and

- investigate the relationships between soil conservation systems and hydrologic response at the plot, field and watershed scales.

HYDROLOGIC MONITORING METHODS

Water Quantity Monitoring

Watershed Scale

Watersheds and microbasins were instrumented with flow monitoring and water quality sampling devices to facilitate the accurate estimation of mass loadings of water quality parameters. In-stream water control devices (v-notch and rectangular weirs) were installed to better define low flow estimates. Water quality shelters were installed at each watershed outlet (two per study area, six in total) to house automated water level monitoring, meteorological, and water quality sampling equipment. Continuous water level data was used in conjunction with flow velocity determination to derive flow-discharge curves for each watershed outlet. The resultant continuous flow record was ultimately used for calculating relationships between flow and water quality concentrations for water quality loading determination.

Microbasin Scale

A total of twelve microbasins (four per study area) were instrumented with automated water level monitoring equipment and manual water quality sampling which were operated during non-winter months. Hydrologic control structures (v-notch weirs and Parshall flume) were installed at each microbasin along with a stilling well for water level-flow estimation purposes.

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Plot Scale

Rainfall simulation techniques were employed to evaluate water quality at the plot scale at critical times of the year when soil conditions may vary due to farm management or seasonal influences (ie. post-fall tillage 1990-91; spring pre-plant 1991-92; and post harvest 1991). Water quality samples were collected in triplicate from three field plots at benchmark sites in both the test and control watersheds to determine water quality loads.

Groundwater Monitoring

One pathway for phosphorus loss is through subsurface soils and groundwater transport. To define the magnitude of this pathway, groundwater monitoring wells were installed in each watershed to determine the amount of phosphorus was transported through the subsurface in the soluble phase. One groundwater monitoring well was installed near each microbasin of each study area. Groundwater samples were collected approximately monthly through the monitoring phase of the study.

RESULTS AND DISCUSSION

Watershed Scale

Runoff

- Essex **control** unit area runoff slightly exceeded **test** runoff over the period of study.
- Kettle Creek **test** unit area runoff exceeded **control** runoff during the wettest seasons.
- Pittock **test** unit area runoff was significantly greater (nearly 50%) than that of the **control** throughout the study period.

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Hydraulic Yield

- Essex and Kettle Creek **test** and **control** watersheds compare closely with respect to hydraulic yield throughout the period of study.
- Pittock **test** had generally higher hydraulic yields than **control**.

Microbasin Scale

Runoff

- Frequency and extent of microbasin flow was quite variable in all microbasins.
- Generally **control** microbasins produced less runoff than **test** microbasins, especially during periods of tillage.

Plot Scale

Rainfall Simulation Results

- Time to ponding (TTP) values, indicating soil porosity, showed no distinct trends when comparing **test** and **control** sites, possibly due to spatial variability of infiltration rates of soils.
- Time to runoff (TTR) values, reflecting soil storage capacity, were not significantly different for **test** or **control** sites, again possibly due to high spatial variability of soil properties .
- Total runoff volume was generally higher for **test** sites than for **control**.
- Runoff volume was lowest for control sites following tillage, likely due to increased surface roughness.
- The difference between **test** and **control** runoff volume is most pronounced during pre-plant and post-tillage, when the difference in surface cover is most pronounced.

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CONCLUSIONS

The following are general conclusions drawn from the PWS concerning hydrology.

- At the watershed scale, the effects of conservation tillage on runoff volume are site specific:
  - Essex: runoff is higher from the **test** watershed due to higher resultant cover in the last 2 years of the study.
  - Kettle Creek: runoff is higher from the **test** watershed during the periods of high annual rainfall.
  - Pittock: the test watershed produced significantly higher unit area runoff volumes throughout most of the study period.
- At the microbasin (field) scale, there is no clear pattern of dependency between unit area runoff and conservation farm management in Kettle or Pittock. In Essex, microbasins generally indicate that increased cover resulting from conservation systems correlates with increased runoff.
- At the plot scale, responses of runoff to the presence of conservation tillage increased cover corresponds to increased runoff in Kettle and Pittock, but in Essex the reverse is true.
- During rainfall simulation, **test** runoff exceeded **control** when all data where analyzed together.
- During rainfall simulation, **control** runoff was lowest during the post-tillage period, most likely due to high surface storage.
- More replication is recommended for plot scale studies, such as rainfall simulation experiments, to reduce the effects of spatial heterogeneity of soil characteristics.
- At the microbasin scale, greater duration of study is required so that more events are available to be used in time trend analysis on individual microbasins. Currently, direct comparisons between different microbasins are confounded by differences in physical and agronomic factors, despite all efforts to avoid such differences when choosing microbasins.
- At the watershed scale, extension of the duration of study to create a larger database would help to more clearly define the effects of tillage and residue on runoff.

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1.0 INTRODUCTION

1.1 Background

The Soil and Water Environmental Enhancement Program (SWEEP) was initiated in 1986 with an overall mandate to:

- reduce Ontario's Non-Point Source (NPS) loadings of phosphorus to Lake Erie from agricultural sources by 200 tonnes; and
- maintain or improve the productivity of the primary agricultural sector in Southwestern Ontario by reducing or correcting soil erosion and degradation.

The Pilot Watershed Study (PWS) is a major SWEEP sub-program aimed at evaluating and demonstrating the benefits of established conservation farming systems at the watershed and smaller scales. Figure 1.1 shows the overall SWEEP organizational structure and the PWS sub-program relationship to the Program. Cooperating agencies; Environment Canada (EC), Agriculture Canada (AC), and the Ontario Ministry of the Environment (MOE) are identified. Beak Consultants Limited (BEAK) is the prime contractor responsible to AC and MOE. Ecologistics Limited (ECOLOGISTICS) is a sub-contractor to BEAK responsible for site selection and the agronomic program of the PWS.

The PWS started in 1987 with detailed study design, staffing, training, cooperator enlistment, and watershed selection. Farm plans were initiated in August, 1988 and environmental monitoring began later the same year.

Monitoring and evaluation were conducted from late 1988 until mid 1992.

Figure 1.2 shows the location of PWS subject areas within the Lake Erie Watershed. These are situated within different yet common agricultural and physical settings.

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The PWS has the following key features:

- four year implementation and monitoring period;
- **test** (conservation oriented systems) and **control** (conventional systems) paired watershed design;
- pro-active agronomic management involving annual farm planning, cooperator compensation program, ongoing producer extension program, availability of conservation-type farm implements, detailed cooperator record keeping, crop scouting and productivity analysis, and farm level socio-economic evaluation;
- intensive and continuous environmental monitoring at plot, field and watershed scales;
- detailed soil survey and soil quality monitoring;
- extensive environmental monitoring program including meteorology, hydrology and water quality; and
- detailed evaluation involving the application of two modelling systems for farm planning and systems evaluation.

The paired watershed study design is a unique approach which relies upon direct comparisons between the **test** and **control** areas as the primary method of environmental and agronomic evaluation. The effects of scale, at whole watershed, farm, field and plot scales are also a fundamental aspect of the study design which systematically addresses the relationship between producer attitudes and adoption as well as between measurable benefits, complexity, and scale.

1.2 Objectives of the Pilot Watershed Study

Objective Regarding Study/Approach

To achieve a high level of adoption of the most appropriate soil and water conservation practices among farm operators utilizing lands in the **test** sub-watersheds.

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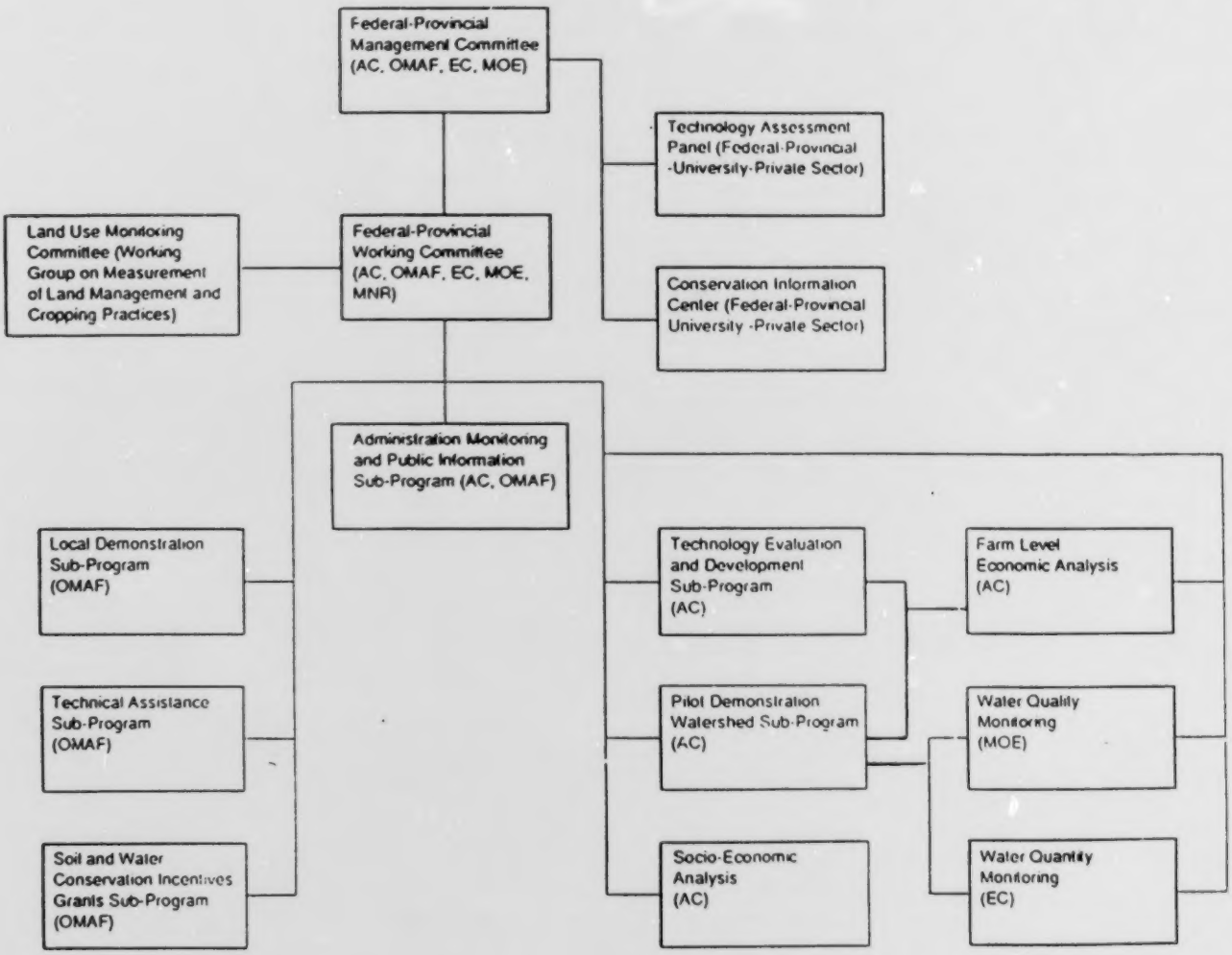
Figure 1.1: SWEEP Organizational Structure


Federal-Provincial Management Committee (AC, OMAF, EC, MOE)
Technology Assessment Panel (Federal-Provincial -University-Private Sector)
Land Use Monitoring Committee (Working Group on Measurement of Land Management and Cropping Practices)
Federal-Provincial Working Committee (AC, OMAF, EC, MOE, MNR)
Conservation Information Center (Federal-Provincial University -Private Sector)
Administration Monitoring and Public Information Sub-Program (AC, OMAF)
Local Demonstration Sub-Program (OMAF)
Technology Evaluation and Development Sub-Program (AC)
Farm Level Economic Analysis (AC)
Technical Assistance Sub-Program (OMAF)
Pilot Demonstration Watershed Sub-Program (AC)
Water Quality Monitoring (MOE)
Soil and Water Conservation Incentives Grants Sub-Program (OMAF)
Socio-Economic Analysis (AC)
Water Quantity Monitoring (EC)

Abbreviations
AC Agriculture Canada
EC Environment Canada
MNR Ontario Ministry of Natural Resources
MOE Ontario Ministry of the Environment
OMAF Ontario Ministry of Agriculture and Food

Strategy

1. Develop and employ a watershed selection process which:

   a) optimizes the probability of farm operator adoption of desirable practices, and
   b) can be applied effectively to critical areas in the larger Lake Erie basin.

2. Develop and utilize improved soil and water conservation planning tools for application at the farm and watershed levels.

3. Develop and utilize contract arrangements with cooperating farm operators which specify and compensate for participation in the project without "buying" their participation.

Objective Regarding Effectiveness

To determine the nature and degree of changes in relevant soil and water quality parameters and crop yields as influenced by "basin-wide" soil and water conservation practices.

Strategy

1. Select pairs of watersheds which are as similar as possible in respect to physiography, hydrology, and farming systems.

2. Develop and apply mechanisms to encourage adoption of soil and water conservation practices throughout the life of the project in the **test** sub-watersheds and to discourage adoption in the **control** sub-watersheds.

3. Establish soil, water and crop yield baseline conditions and monitor changes in relevant parameters throughout the life of the sub-program.

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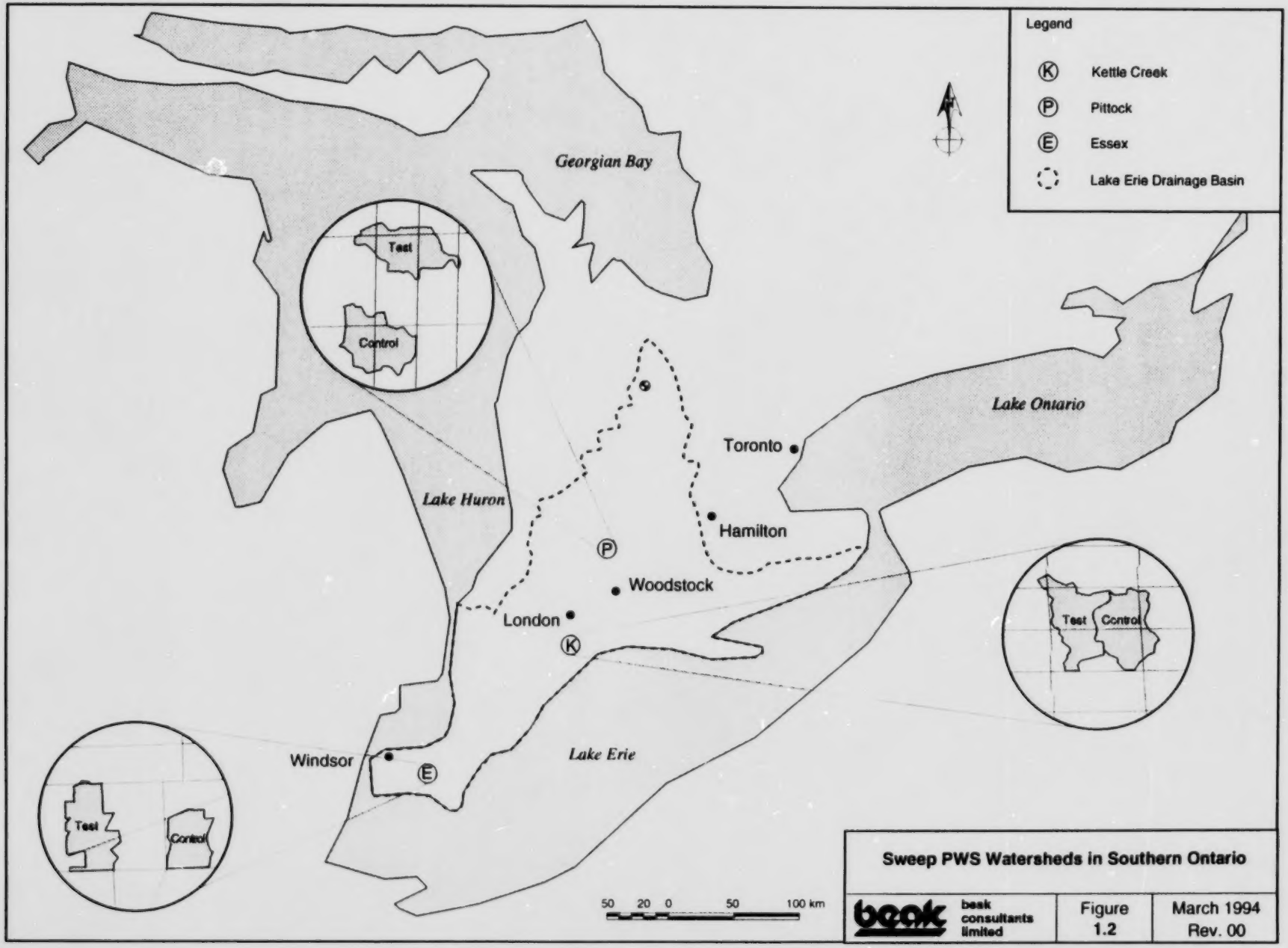
Legend
Kettle Creek
Pittock
Essex
Lake Erie Drainage Basin
Georgian Bay
Test
Control
Lake Huron
Lake Ontario
Toronto
Hamilton
Woodstock
London
Windsor
Lake Erie
50 20 0 50 100 km
Sweep PWS Watersheds in Southern Ontario
beak consultants limited
Figure 1.2
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4. Correlate changes in soil, water and crop yield parameters to soil and water conservation practices and systems.

5. Evaluate improvements to planning tools (models) achieved during the sub-program.

6. Evaluate factors that affect the adoption of soil and water conservation practices and that influence farmer attitudes towards both the practices and the goals of the sub-program.

Objective Regarding Information Dissemination

To prepare information about sub-program activities and results and to transmit this to participating farmers and other related SWEEP sub-programs.

Strategy

1. Collect and transmit, as required, to the SWEEP sub-program contractor responsible for the farm-level and basin-wide economic analysis.

2. Prepare information on activities and results for the communications sub-program contractor.

3. Prepare periodic reports to cooperating farmers on activities and results in written and meeting formats.

1.3 Report Structure

The overall PWS reporting has been sub-divided into the following categories:

- Report #1 - Study Area Selection, Description and Climate;

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- Report #2 - Implementation of Conservation Systems;
- Report #3 - Evaluation of Conservation Systems, Social Factors;
- Report #4 - Evaluation of Conservation Systems, Soils and Crops;
- Report #5 - Evaluation of Conservation Systems, Hydrology;
- Report #6 - Evaluation of Conservation Systems, Water Quality;
- Report #7 - Modelling; and
- Report #8 - Executive Summary.

Each report is a stand alone document including a summary, descriptions of objectives, methodologies, observations, discussion, and summarized listings of relevant data where applicable. The Executive Summary is a compilation of summaries from all of the technical reports.

This report documents the modelling activities undertaken as part of the PWS.

1.4 Specific Objectives

Models of watershed erosion and runoff have been used for three purposes in the Pilot Watershed Study, namely; as planning and communication aids at the individual farm level, as aids to system analysis, and as long term land and water quality management tools. The former purpose mentioned above is documented and discussed in Report #2, Implementation of Conservation Systems, as it was a key component of the Farm Planning aspects of the study. The latter two purposes are discussed in this report. Specifically, the objectives of this component of the study are as follows:

- develop spatially descriptive models for the six study sub-watersheds;
- develop parameter inputs for application of a screening level land management tools (GAMESP) and for a dynamic process land and water quality model (HSPF);

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- apply both screening and detailed models to comparing sub-watershed pairs in terms of inherent erosion potential and erosion-runoff behaviour during the transition to conservation farming in the test sub-watersheds; and
- apply both models to evaluate long term soil and water quality consequences from various land management schemes.

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2.0 MONITORING INSTALLATIONS AND METHODS

Water quantity monitoring in the PWS is extensive with an automatic water level-flow recording installation and a control device at the mouth of each sub-watershed, six in all. In addition, there are two microbasin monitoring installations in each sub-watershed, twelve in all. Each of these sites has a water level recording instrument and a hydraulic control device. Groundwater and soil moisture are also monitored as a measure of water in storage and baseflow supply.

2.1 Watershed Outlets

The Water Survey of Canada (WSC) installed sub-watershed mouth flow monitoring stations, instrumented these for flow recording, and operated the installations continually throughout the study period (1989-92). BEAK installed and instrumented the microbasin stations and operated these facilities during the study period.

The location of the sub-watershed mouth flow monitoring stations are identified in Figures 2.1 to 2.3 for the three study watersheds. These installations are identical in terms of housing, instrumentation and operation. Each of the six stations has an ARMCO type shelter (1.6 m x 2.4 m x 2.4 m) set atop a concrete base and a 1 m diameter steel stilling well. The well is electrically heated and hydraulically connected to the drain by a buried pipe. The shelters are electrically heated and lighted for year round operation. Table 2.1 summarizes station installation information.

Each watershed mouth station is equipped with a Leopold and Stevens A71 float activated continuous recording water level gauge. The **test** sub-watershed stations are additionally equipped with recorder encoders and Campbell Scientific 21X data loggers. The data loggers at these three stations can be remotely interrogated by telephone-modem link. This allows for the remote monitoring of water levels and mobilization of field crews during significant events.

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Figure 2.1. Essex environmental monitoring sites

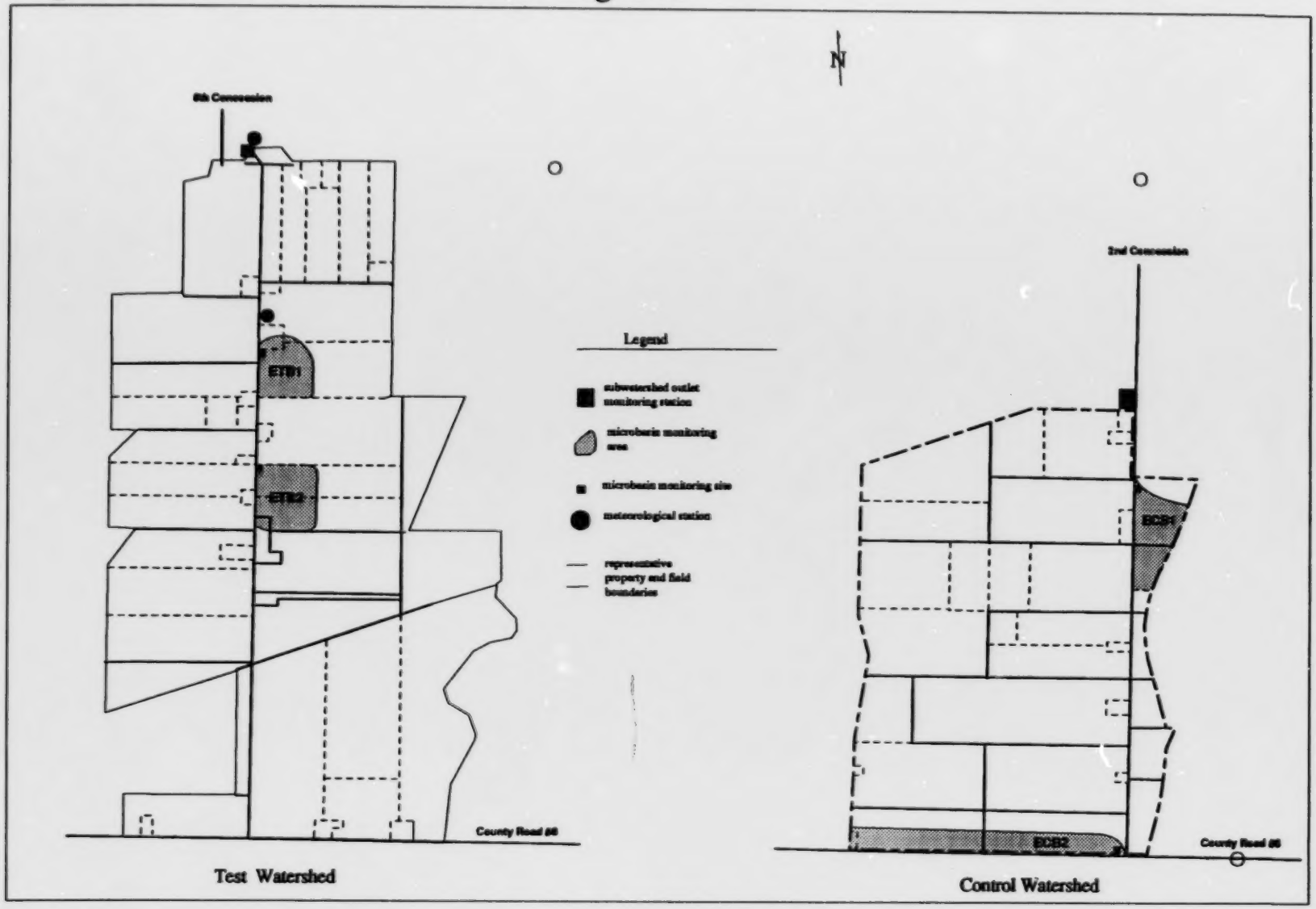

Figure 2.2. Kettle environmental monitoring sites

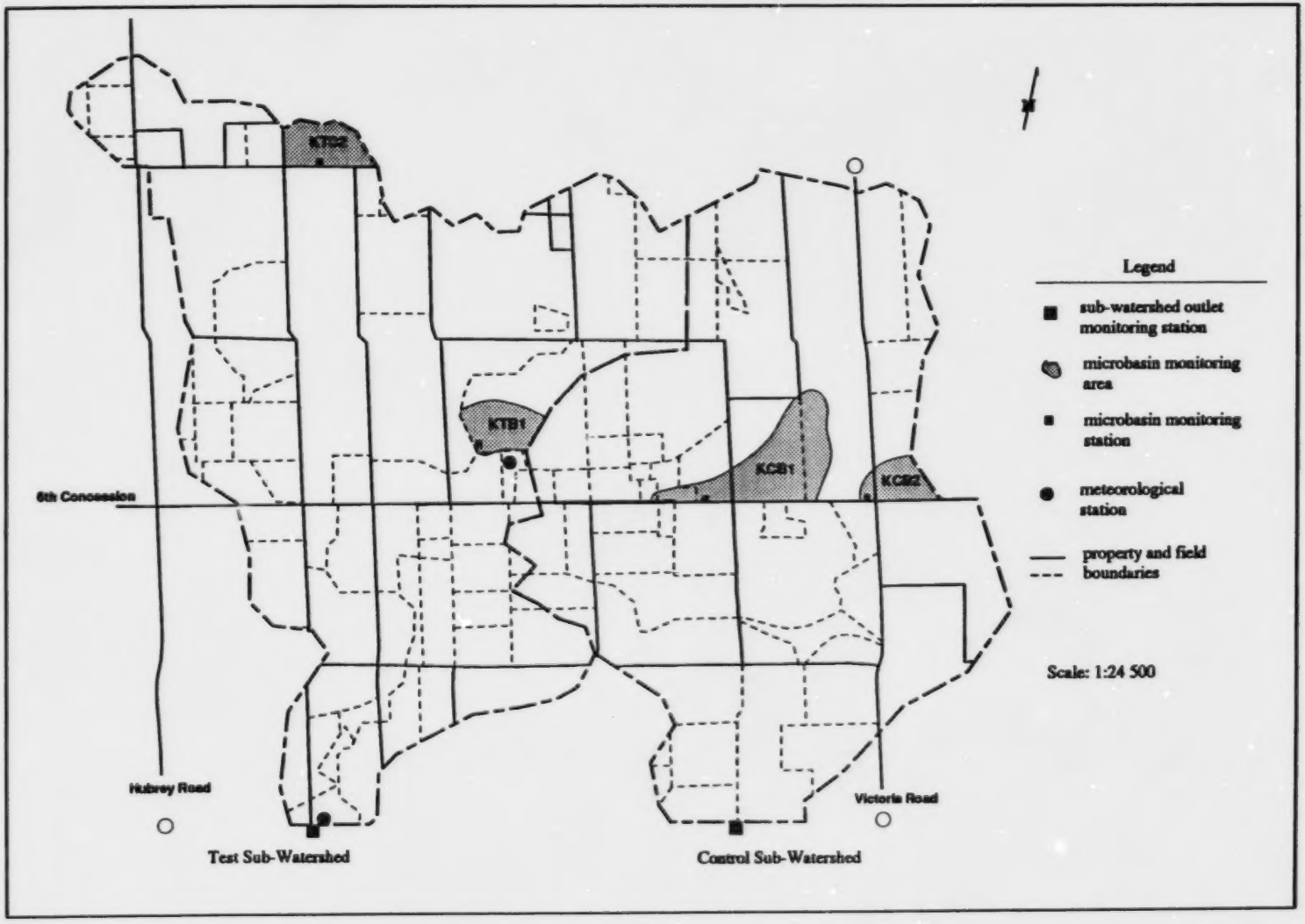

Figure 2.3. Pittock environmental monitoring sites

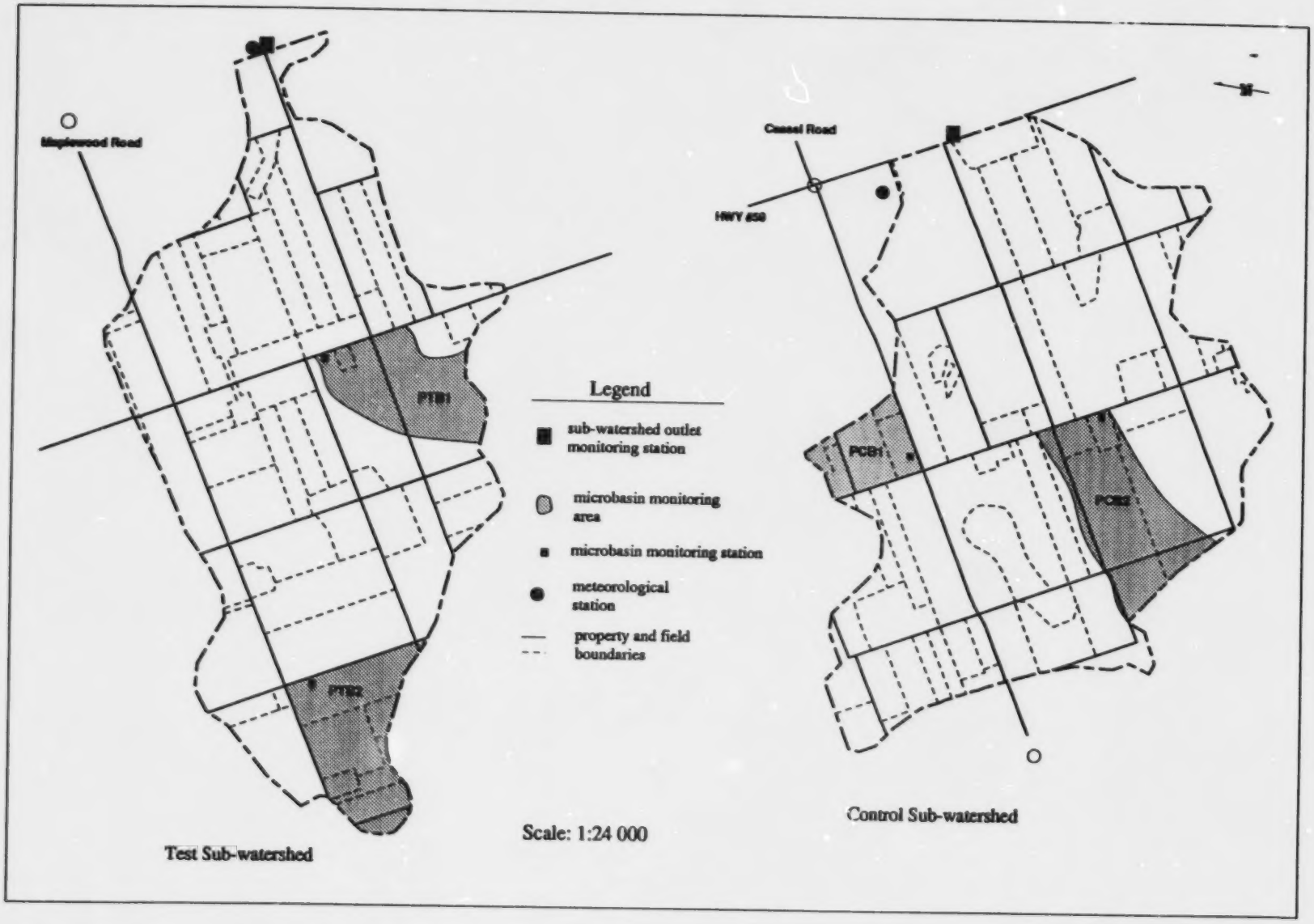

TABLE 2.1: SCHEDULE OF ENVIRONMENTAL MONITORING STATION INSTALLATIONS (1988 TO 1992)

		WSC		MOE	
Watershed	Sub-Watershed	Shelter Erected	Water Level Recorder Installed	ISCO Water Sampler Installed	Campbell Datalogger Meteorological Instruments*
Essex	Test	Oct. 88	Jan. 89	March 89	Data logger: Jan. 89 (no power) Soil Probes: Dec. 99
	Control	Oct. 88	Jan. 89	March 89	------
Kettle Creek	Test	June 88	July 88 Encoder - June 89	Sept. 88	Data Logger: Aug. 88 Soil Probes: Jan. 89
	Control	June 88	July 88	Sept. 88	------
Pittock	Test	June 88	July 88 Encoder - June 89	Sept. 88	Data Logger: Sept. 88 Soil Probes: Dec. 88
	Control	June 88	July 88	Sept. 88	------

*includes:

- air temperature
- rainfall rate
- water temperature
- soil temperatures (3 depths)
- relative humidity (Kettle Creek only)

Due to very low flows at these sites and a lack of adequate hydraulic control, concrete weirs with galvanized steel V-notches were installed in each drain. Flow rates as low as 0.5 L/s were recorded at these sites.

The WSC conducts manual flow measurements at each of the six sites frequently during base flow and runoff periods. A Price 622A current meter, sounding rod and measuring tape are used to make flow estimates over a wide range of water levels. A rating curve has been developed for each site using this information. In turn, water level records are converted to daily mean and hourly discharges and transferred to BEAK on diskette and hard copy. Due to the rapid peaking of water levels at these sites, short term flow rate changes, and temporary or transient backwater effects caused by weeds and ice in the drains, frequent flow measurements to confirm the stage-discharge relationships are necessary throughout the year. Errors in streamflow estimation within the PWS dataset are inevitable due to stage discharge curve shifts, ice blockage and extreme high or low flow rates which lie beyond the range of the stage-discharge curves. However, in general the streamflow record is reliable, especially in terms of daily and longer term flow volumes.

The Kettle Creek stations were installed in July 1988, the Pittock stations were installed in August 1988, and the Essex stations began operation in January 1989. The Kettle Creek stations have displayed continually shifting stage-discharge curves as a result of ice and weed growth in the channels. Frequent flow measurements are necessary at these sites. The Essex stations have displayed some stage-discharge curve shifts, but not as severe as at Kettle Creek. The Pittock stations have been relatively stable.

The WSC has prepared a report documenting the six installations, their operation and problems encountered to date, (WSC, 1990).

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2.2 Microbasins

Microbasin monitoring stations have been set-up at sites which provide adequate hydraulic control for surface runoff (Figures 2.1 to 2.3). These stations have been selected so that surface runoff only is monitored and all of the surface runoff from a microbasin is collected. That is, there are no tile drain outfalls or drop inlets upstream of these sites. Microbasins represent field sized areas and primary spatial delivery units. Microbasin characteristics are summarized in Table 2.2.

Table 2.3 provides a description of each microbasin installation, as they differ in several respects. Flow recording instruments are protected at each site (except ETB2 and ECB1) by locking covers set atop stilling wells (except KCB2 which has a weir box). Stilling wells are connected hydraulically to just upstream of the V-notches with a buried steel pipe. Stilling wells are made from 0.3 m diameter galvanized steel culverts. The V-notch weirs are made of aluminum and are fastened to a wooden frame built around the upstream end of the culverts. At KCB2 there is a weir box which captures flow from the road culvert, provides some stilling and discharges through a V-notch. Stations ETB2 and ECB2 have Parshall flumes set into road ditches. Water levels are measured in small stilling wells attached to the flumes. Data loggers were installed on the Kettle Creek mechanical water level recorders in the spring of 1991.

Recording flow metres are left in the place at all times, except for ETB2 and ECB1 which are deployed as required. Independent flow measurements have been made at some sites to verify theoretical relationships for V-notches and flumes.

Errors in flow measurement at the microbasin scale are due to short term blockages (i.e. debris, weeds, ice), backwater effects and extreme high flows which exceeded the design capacity of the control device. Our analysis of microbasin scale data is somewhat selective in that we have flagged questionable event data and excluded it from detailed evaluation.

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TABLE 2.2: PHYSICAL MICROBASIN CHARACTERISTICS

Microbasins	Area (ha)	Slope Length[1] (m)	Slope (%)
ETB1	5.3	135	<0.5
ETB2	6.1	115	<0.5
ECB1	8.2	100	<0.5
ECB2	13.8	60	<0.5
KTB1	6.5	115	3.5
KTB2	5.1	185	1.7
KCB1	8.5	335	2.5
KCB2	4.1	180	2.6
PTB1	24.8	385	0.70
PTB2	28.0	515	0.26
PCB1	12.8	265	1.0
PCB2	20.0[2]	265	0.38

[1] Slope length estimated at 75% of the maximum microbasin length.
[2] The presence of a drop inlet in this microbasin makes the area estimate approximate.

TABLE 2.3: MICROBASIN FLOW MONITORING INSTALLATIONS

Station Number	Location	Hydraulic Control	Water Level Recorder	Installation Date (MM/YY)
ETB1	Essex test, drain on east side of 5th Concession	90° V-notch on culvert	Stevens F type	03/89
ETB2	Essex test, drain on east side of 5th Concession	2" Parshall flume in ditch	ISCO bubbler type, Model 1870	03/89
ECB1	Essex control, drain on east side of 2nd Concession	1" Parshall flume in ditch	ISCO bubbler type, Model 1870	03/89
ECB1	Essex control, culvert at 2nd Concession and County Road #8	90° V-notch on culvert in ditch	ISCO bubbler type, Model 1870	03/89
KTB1	Beside Madter Drain (TEST) on Vessie Farm	90° V-notch set into a berm beside drain	Stevens F type/Data Logger	05/89
KTB2	On upstream side of road culvert on 4th Concession (TEST)	90° V-notch on culvert in ditch	Stevens F type/Data Logger	04/89
KCB1	On upstream side of road culvert on 5th Concession (CONTROL)	90° V-notch on culvert in ditch	Stevens F type/Data Logger	04/89
KCB2	On downstream side of road culvert on 5th Concession at Victoria Road (CONTROL)	Weir box on culvert with 90° V-notch outlet	Stevens F type/Data Logger	04/89
PTB1	Pittock test, on west side of Highway #59 at Pioneer Seeds	90° V-notch on culvert under driveway	Montedoro-Whitney Q logger	09/89
PTB2	Pittock test, on west side of 11th Concession, south of Maplewood Road	90° V-notch on culvert in ditch	Montedoro-Whitney Q logger	04/89
PCB1	Pittock control, on north side of Castle Road, near 11th Concession	90° V-notch on drop inlet	Montedoro-Whitney Q logger	04/89
PCB2	Pittock Control, on west side of 11th Concession, south of Castle Road	90° V-notch on culvert in ditch	Montedoro-Whitney Q logger	04/89

2.3 Rainfall Simulator

In this study, plot scale research was carried out using a portable rainfall simulator developed by Tossell *et al.* (1987) at the University of Guelph. This aspect of the study allowed for controlled experimentation with a constant rainfall intensity and specific land uses. This system provides a relatively uniform simulated rainstorm on plots measuring 1 m x 1 m. Sampling sites were located on a midslope position in each of the six sub-watersheds in the PWS. Three replicate plots were measured at each sampling site. The sites were chosen based on the cropping and tillage practices within the field. Sites on the **control** sub-watersheds were established on fields where conventional tillage practices (fall moldboard plowing) occurred. **Test** sites were established on sites with the same crop but with a conservation management practice. In all cases, attempts were made to select sites with similar soils and slopes but the most important factor in site selection was crop due to the influence of residue on runoff and water quality. Due to differing crop rotations, the same sites were not always used throughout the study but in all cases, the crop was a consistent factor at least within each sub-watershed pair.

Simulations were conducted five times in order to identify any seasonal effect on runoff volumes. Rather than the actual date, the condition of the soil in terms of tillage operation was used to determine the "seasons" of measurement. Each time, replicated runs were performed on the **test** and **control** sites on the same day. The only exception was in the fall of 1991 when runs were carried out only once on the Kettle Creek and Pittock **test** sites. Since no tillage or other activities were to occur in the **test** fields after harvest, the results obtained on these sites for PH91 (post harvest in 1991) were used to compare with the **control** sites for PH91 and PT91 (post fall tillage in 1991). Care was taken to ensure that soil conditions for the PT91 runs at Kettle Creek and Pittock were similar to those of the PH91 runs in terms of soil moisture. Table 2.4 provides a list of the times of measurement and the identification codes that will be used throughout the remainder of this discussion.

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Table 2.4: Season and Tillage Conditions During Rainfall Simulation Runs

SEASON	TILLAGE CONDITIONS	IDENTIFICATION CODE
Fall 1990	Post Fall Tillage	PT90
Spring 1991	Pre Plant	PP91
Fall 1991	Post Harvest	PH91
Fall 1991	Post Fall Tillage	PT91
Spring 1992	Pre Plant	PP92

The plots were set up as described by Wall *et al.* (1990). Prior to the onset of simulated rainfall, several measurements including soil texture, moisture content, slope and residue cover were taken. Soil texture was measured one time only on each site and analyzed using the pipette method (McKeague, 1978). When simulation sites were changed due to crop rotations, new samples were taken and submitted for analysis. Moisture content was determined by taking small soil samples just outside the four corners of each plot, placing them in a plastic bag and determining their gravimetric moisture content in the laboratory (McKeague, 1978). Slope was calculated as the difference in distance (cm) from the soil to a level meter stick from the top of the plot to the lip at the bottom end on each side of the plot. Residue cover was determined using the knotted rope method. Here, a 1 m long string was knotted every 4 cm for a total of 25 knots along the string. The string was laid across the soil surface within the plot perpendicular to the direction of the crop row 4 times. The presence of a piece of crop residue (dead and alive) under a knot was noted. A total 100 knots were examined and consequently, the sum of knots touching crop residue was taken as the percent cover for that plot.

Once the initial measurements were made, rainfall simulation commenced. An intense rainfall was used to simulate the worst case scenario. The use of the 1.27 cm nozzle (1/2 inch), 1.5 m from the ground surface, simulating rainfall for a period of 10 minutes at an intensity of 2.67 mm/min resulted in a total rainfall of 2.67 cm (26.7 litres). The return period of such a storm is approximately 50 years.

During each simulation, time to ponding (TTP) and time to runoff (TTR) were noted. Time to ponding was taken as the time when puddles began to form on the soil surface. Time to runoff was the time when runoff first travelled off of the plot and into the collection device. Once runoff began, the volume collected was noted every minute until the end of the run. After ten minutes, the total runoff collected plus that remaining in the collection trough were totalled to obtain a total runoff volume for that run.

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Statistical analyses (t-tests and ANOVA's) were performed to determine if significant differences existed between **test** and **control** sites, watersheds and seasons. Duncan's Multiple Range test was used to identify significantly different values. Correlations were run to determine any relationships among runoff, soil moisture, residue, slope, time to ponding and time to runoff. Multiple regression analysis was also carried out to establish an equation for predicting runoff.

Water quality parameters were measured from the collected runoff and results of these analyses are discussed in the water quality report (#5).

2.4 Groundwater

Groundwater monitoring in the study addressed soil moisture and groundwater levels as a measure of antecedent moisture and the potential for baseflow. Groundwater levels were monitored at two sites in each sub-watershed, twelve in all, near the microbasin installations. This was accomplished using piezometers and routine water level measurement. From December 7 to 14, 1988, piezometers were installed using one and one half inch diameter schedule 40 PVC pipe. A three foot section of slotted screen (0.1 mm openings) was attached to the bottom and a threaded PVC cap to the top of a five foot riser section of pipe. The pipes were placed in augered holes and backfilled with sand to the depth of the slotted screen. A peltonite seal was backfilled atop the sand to a further depth of about 30 cm. Native soils were used to backfill to the top of the excavation. These installations were designed to exclude foreign particulate material and surface seepage. Groundwater piezometers were purged dry several times over the first few months to flush any foreign particulate material. Water levels were recorded weekly to bi-weekly throughout the study period.

Gypsum blocks were buried at a depth of 30 cm and 90 cm beside the piezometers in all cases. Gypsum block leads were attached to the top of the piezometer for easy access. A Delmhorst KS-1 soil moisture detector was used to record negative pressure in kPa as an

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indicator of soil tension. A dry soil has a greater tension which indicates that more energy is required to draw water from the soil matrix.

Saturated soils have 0 negative pressure. Soil moisture measurements were made at the same frequency as groundwater level measurements. Gypsum blocks are damaged by freeze-thaw and therefore it was necessary to replace them occasionally during the study.

Figures 2.4 to 2.9 show the location of groundwater piezometers and soil moisture block installations in the six sub-watersheds.

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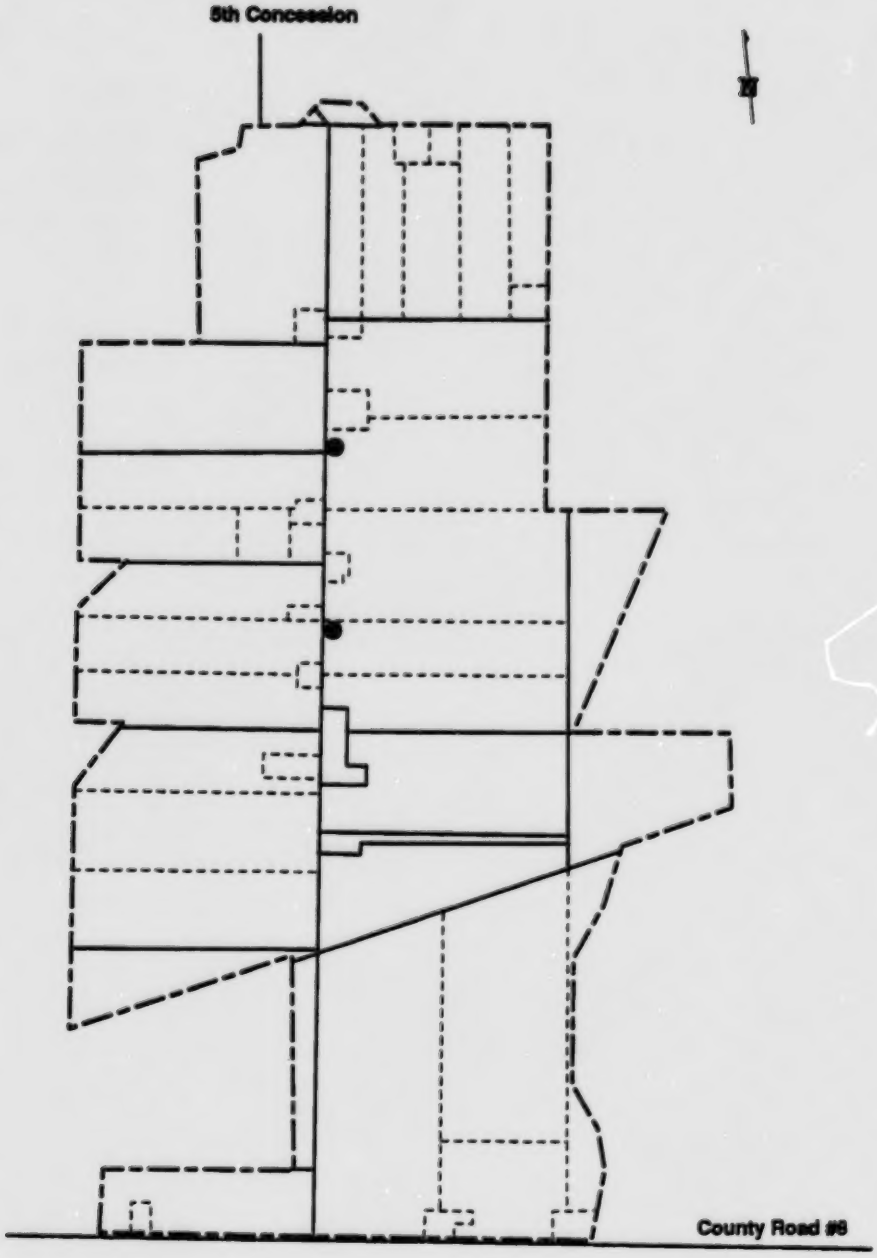

FIGURE 2.4 ESSEX TEST SUB-WATERSHED
Piezometer/Soil Moisture Monitoring Locations

● Soil Moisture and Groundwater Monitoring Site

Scale 1:16 000

100m 0 100m 500m 1 km

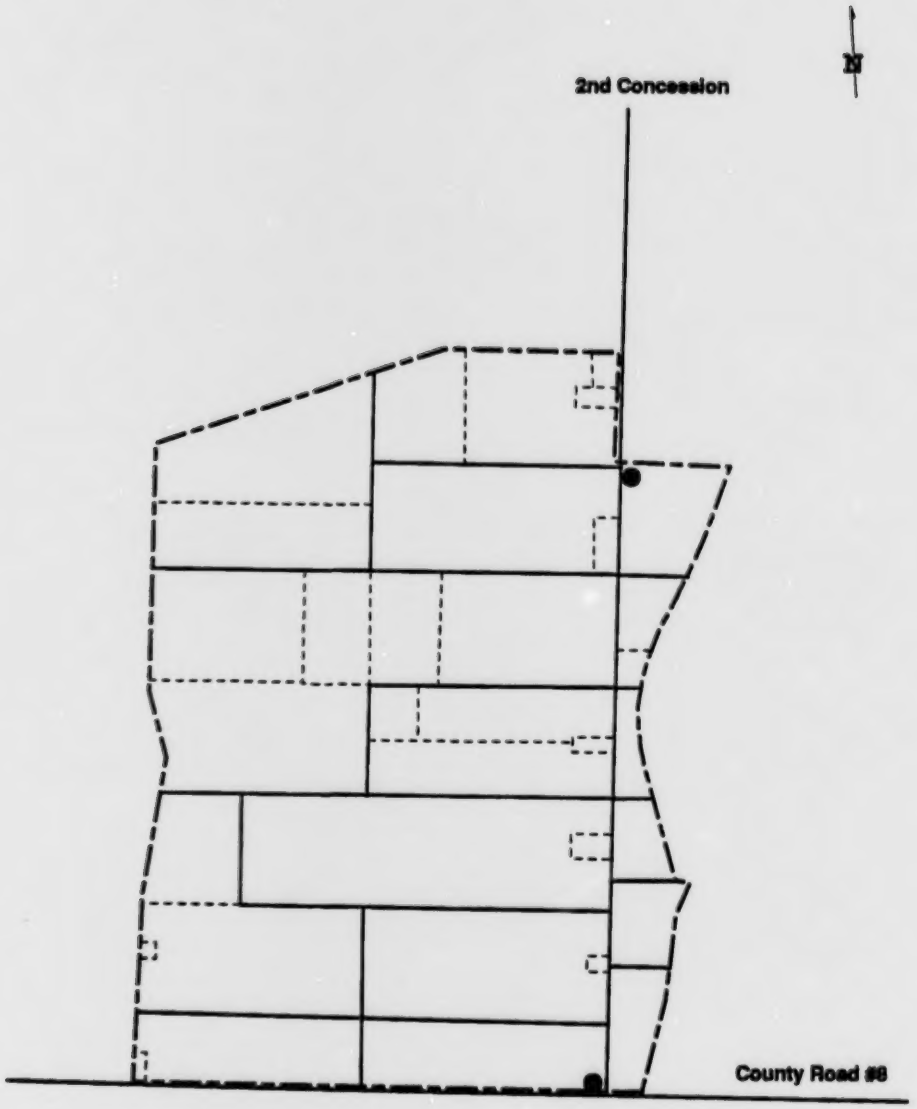

FIGURE 2.5 ESSEX CONTROL SUB-WATERSHED

Piezometer/Soil Moisture Monitoring Locations

● Soil Moisture and Groundwater Monitoring Site

Scale 1:16 000

100m 0 100m 500m 1 km

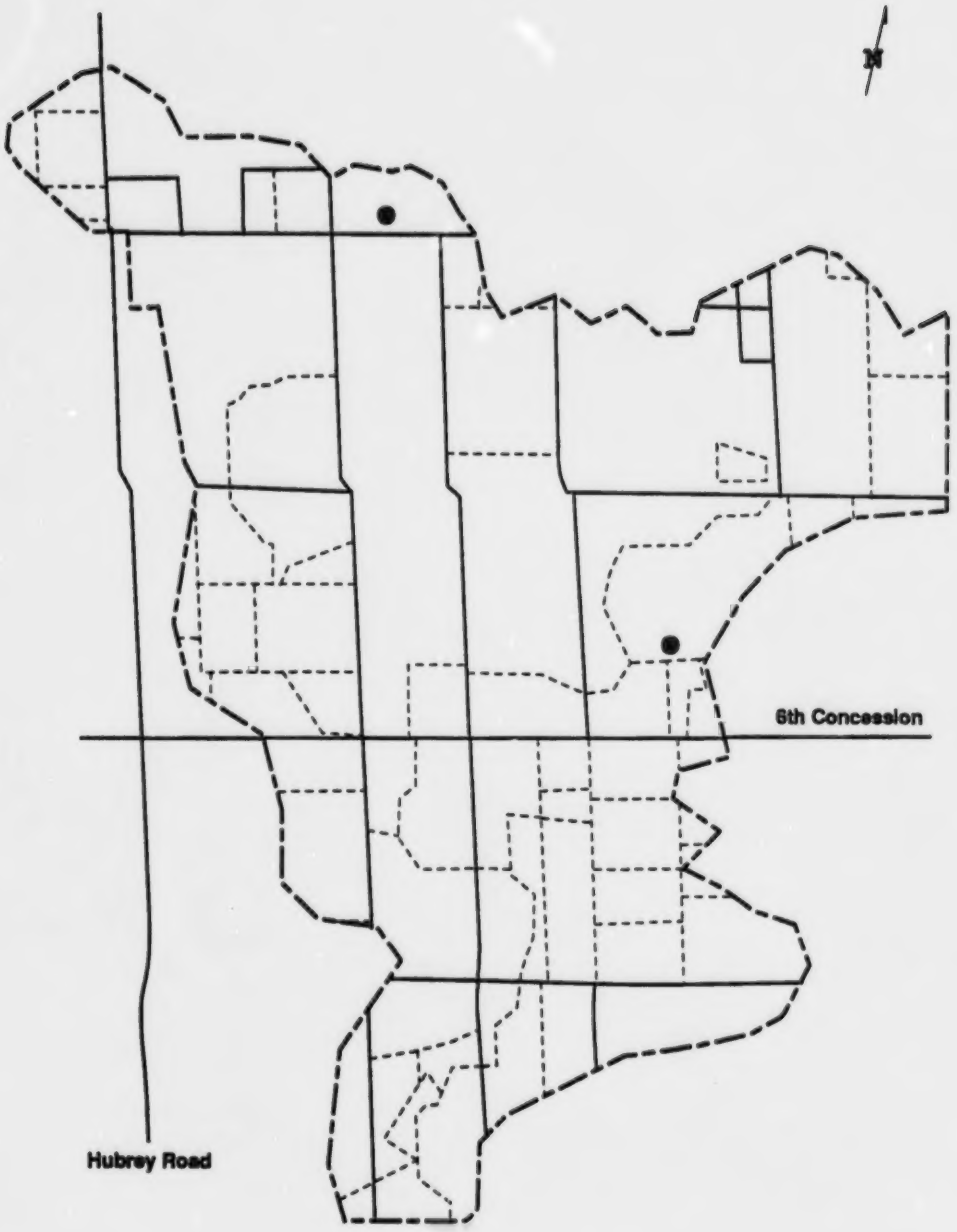

FIGURE 2.6 KETTLE TEST SUB-WATERSHED
Piezometer/Soil Moisture Monitoring Locations

● Soil Moisture and Groundwater Monitoring Site

Scale 1:16 000

100m 0 100m 500m 1 km

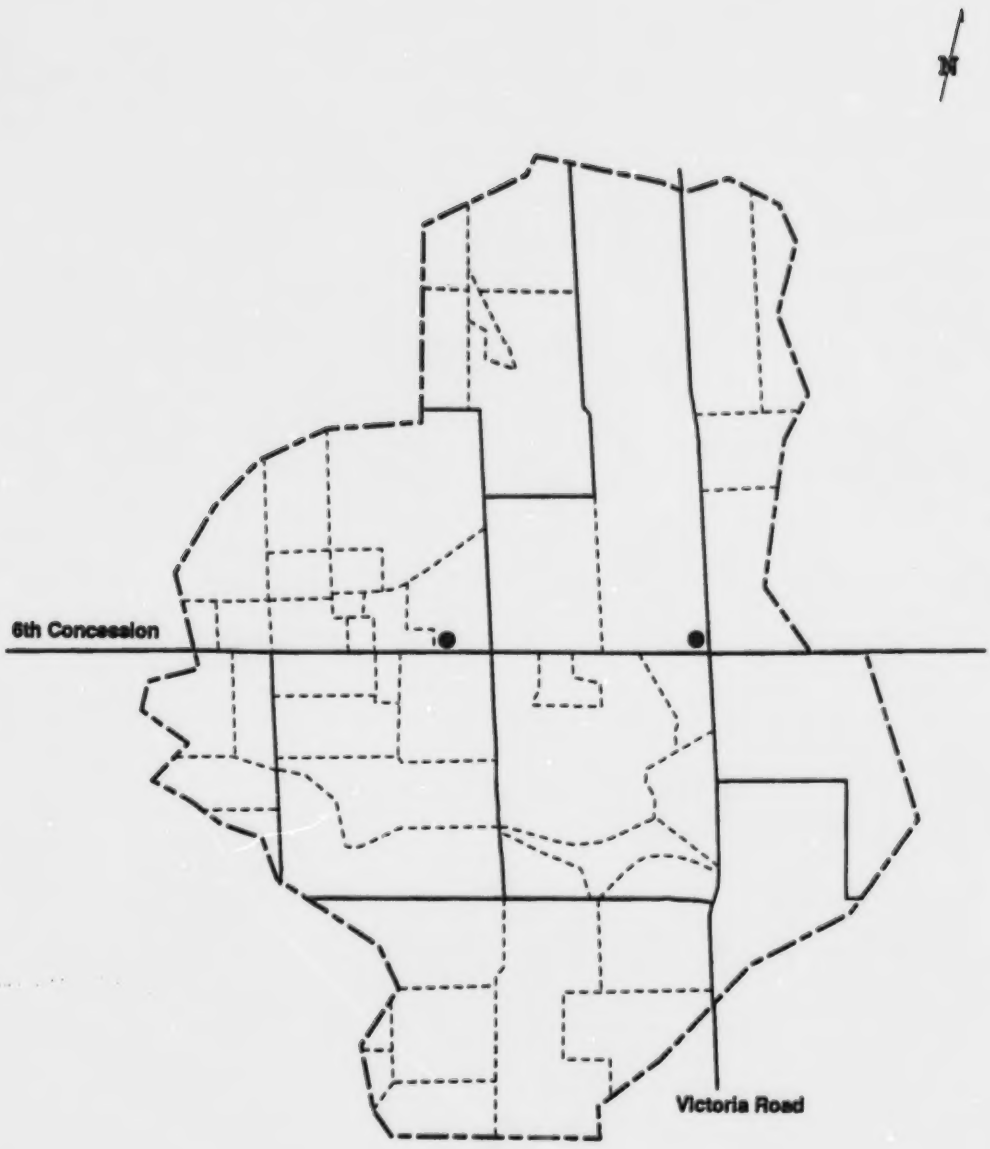

FIGURE 2.7 KETTLE CONTROL SUB-WATERSHED
Piezometer/Soil Moisture Monitoring Locations

● Soil Moisture and Groundwater Monitoring Site

Scale 1:16 000

100m 0 100m 500m 1 km

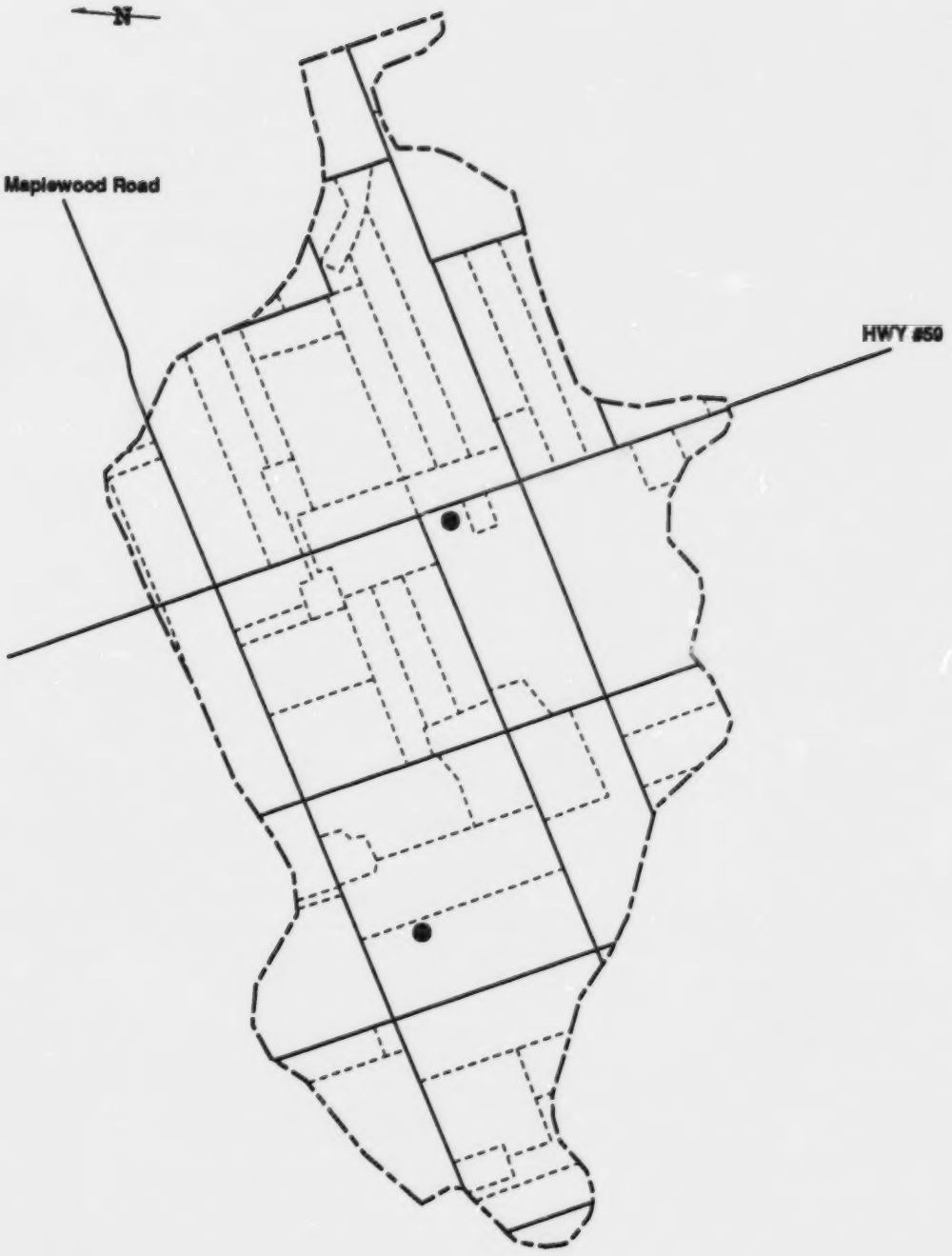

FIGURE 2.8 PITTOCK TEST SUB-WATERSHED

Piezometer/Soil Moisture Monitoring Locations

● Soil Moisture and Groundwater Monitoring Site

Scale 1:16 000

100m 0 100m 500m 1 km

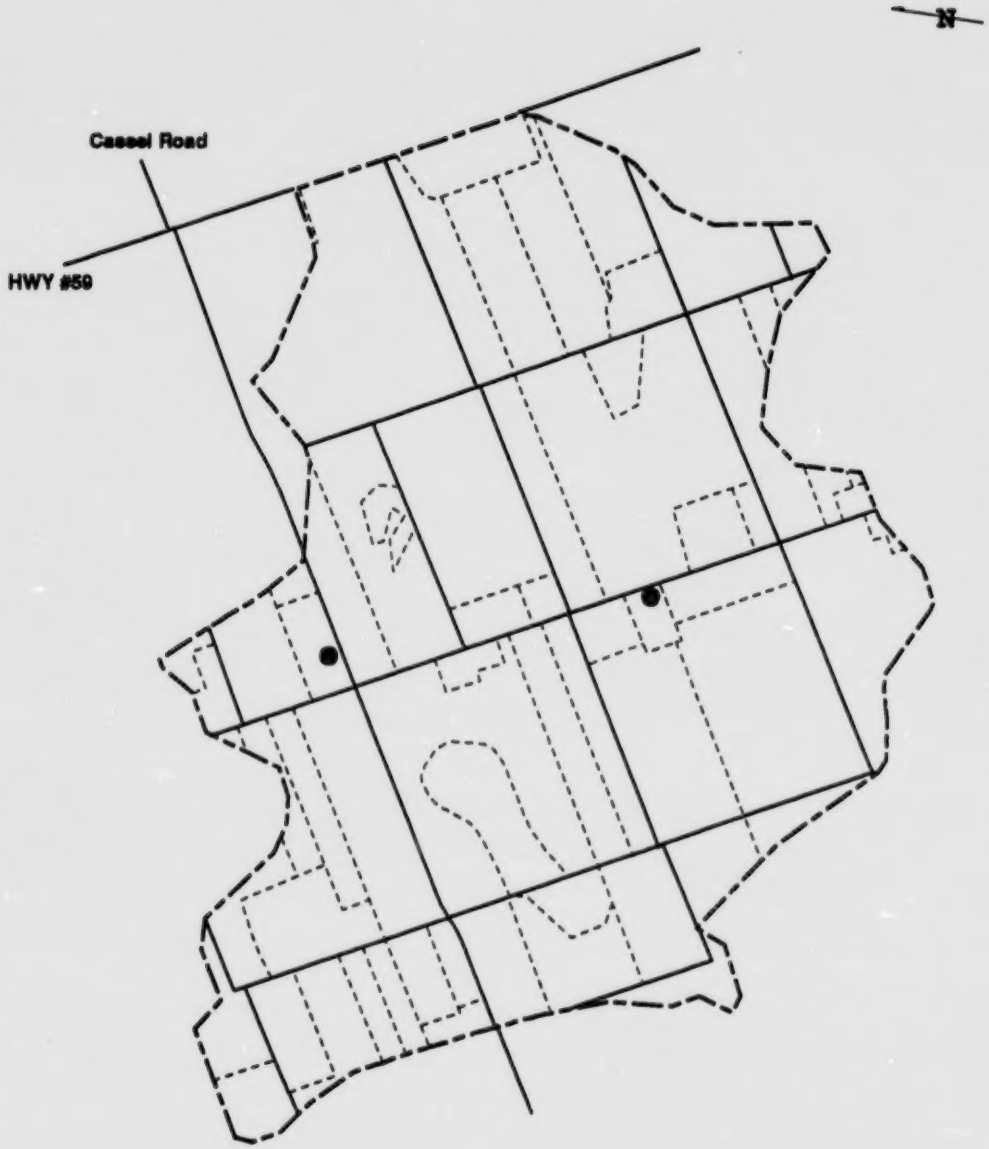

FIGURE 2.9 PITTOCK CONTROL SUB-WATERSHED

Piezometer/Soil Moisture Monitoring Locations

● Soil Moisture and Groundwater Monitoring Site

Scale 1:16 000

100m 0 100m 500m 1 km

3.0 OBSERVATIONS AND EVALUATION

3.1 Watershed Scale

3.1.1 General Observations

The hydrologic cycle at the watershed scale conforms to the following balance of hydraulic fluxes.

INPUTS	OUTFLOW
• Precipitation (snow and rainfall)	• Streamflow • Evapotranspiration • Direct withdrawals • Losses to regional water table

In the longterm, inputs must equal outflow. In the short term, changes in storage (soil, plant and depression) will account for the differences which can be quite significant.

The behaviour of a watershed is dependent upon a complex set of processes and watershed characteristics including the following:

- surface and subsurface soil characteristics (i.e. infiltration rates, bulk densities, porosity, hydraulic conductivity);
- slopes;
- slope lengths;
- surface roughness;
- land cover and crops;
- drainage configuration; and
- channel characteristics.

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In the PWS, sub-watersheds were chosen to reduce the variability of these factors between pairs as much as possible (see Report #1). However, differences do exist and sub-watersheds behave differently under similar weather conditions. Tables 3.1 to 3.3 list monthly outflows from Essex, Kettle Creek and Pittock sub-watersheds respectively. Figures 3.1 to 3.3 display seasonal unit area flows by sub-watershed. Figures 3.4 to 3.6 show the daily total flows for each watershed. From Tables 3.1 to 3.3 and Figures 3.1 to 3.3, various generalities can be drawn including the following.

- Essex **control** unit area runoff consistently exceeded **test** (see Figure 3.1) on a seasonal basis from 1989 to the winter of 1991. Thereafter, the **test** unit area runoff consistently exceeded **control** and may reflect changes in runoff hydrology due to the implementation of conservation systems in the **test**. However, over the entire study period, the **control** unit area flow rate exceeded that in the **test** by about 8%. Summer months in 1989 and 1991 produced little to no flow from these watersheds.

- Kettle Creek **test** unit area runoff exceeds the **control** watershed unit area runoff (see Figure 3.2) during the wettest seasons which occurred in 1990 and early 1992. During dry periods, no clear trend is apparent. The **test** sub-watershed produced about 6% more runoff over the study period than the **control** sub-watershed. The summer months of 1989 and 1991 produced little to no flow within these watersheds. Both sub-watersheds produced similar amounts of runoff and were just short of the Essex totals.

- Pittock **test** watershed unit area runoff generally exceeds **control** runoff with only two significant exceptions, winter and spring of 1991. The total unit area runoff from Pittock **test** sub-watershed exceeded **control** by almost 50% over the study. In the fall of 1990 and winter of 1992 the **test** unit area runoff exceeded control by more than 100%. Pittock produced significantly less runoff than Essex and Kettle Creek in unit area terms.

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TABLE 3.1: STREAMFLOW SUMMARY (JANUARY 1989 TO JUNE 1992) ESSEX SUBWATERSHED MAIN OUTLETS

Month	TEST								CONTROL							
	Flow Volume (cubic dam)				Unit Area Flow Volume (cubic dam/ha)				Flow Volume (cubic dam)				Unit Area Flow Volume (cubic dam/ha)			
	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992
Jan.	46.1	158.0	115.0	83.7	0.106	0.363	0.264	0.192	38.5	147.0	84.8	46.8	0.137	0.523	0.302	0.167
Feb.	12.5	437.0	139.0	435.0	0.029	1.005	0.320	1.000	8.7	337.0	115.0	221.0	0.031	1.199	0.409	0.786
Mar.	66.7	100.0	70.7	228.0	0.153	0.230	0.163	0.524	51.7	92.6	43.1	148.0	0.184	0.330	0.153	0.527
Apr.	163.0	141.0	173.0	187.0	0.375	0.324	0.398	0.430	119.0	69.4	122.0	118.0	0.423	0.247	0.434	0.420
May	130.0	99.2	54.9	25.5	0.299	0.228	0.126	0.059	78.0	77.6	22.8	12.0	0.278	0.276	0.081	0.043
June	256.0	20.5	87.8	17.7	0.589	0.047	0.202	0.041	171.0	48.7	31.7	4.8	0.609	0.173	0.113	0.017
July	85.1	3.0	0.0	-	0.196	0.007	0.000	-	66.9	7.3	0.0	-	0.238	0.026	0.000	-
Aug.	0.2	34.3	0.0	-	0.000	0.079	0.000	-	0.1	10.8	0.0	-	0.000	0.038	0.000	-
Sept.	5.6	375.0	0.0	-	0.013	0.862	0.000	-	1.8	335.0	0.0	-	0.006	1.192	0.000	-
Oct.	2.3	404.0	22.2	-	0.005	0.929	0.051	-	2.7	290.0	4.8	-	0.010	1.032	0.017	-
Nov.	14.3	80.1	63.2	-	0.033	0.184	0.145	-	9.9	92.7	17.1	-	0.035	0.330	0.061	-
Dec.	0.7	741.0	67.2	-	0.002	1.703	0.154	-	1.2	495.0	36.5	-	0.004	1.762	0.130	-
Year	782.5	2593.1	793.0	976.9	1.799	5.961	1.823	2.246	549.5	2003.1	477.8	550.6	1.956	7.128	1.700	1.960

TABLE 3.2: STREAMFLOW SUMMARY (JANUARY 1989 TO JUNE 1992) KETTLE CREEK SUBWATERSHED MAIN OUTLETS

Month	TEST								CONTROL							
	Flow Volume (cubic dam)				Unit Area Flow Volume (cubic dam/ha)				Flow Volume (cubic dam)				Unit Area Flow Volume (cubic dam/ha)			
	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992
Jan.	68.4	291.0	42.9	247.0	0.167	0.710	0.105	0.602	62.2	234.0	53.0	165.0	0.176	0.661	0.150	0.466
Feb.	15.4	437.0	136.0	352.0	0.038	1.066	0.332	0.859	13.3	336.0	118.0	282.0	0.038	0.949	0.333	0.797
Mar.	141.0	275.0	218.0	171.0	0.344	0.671	0.532	0.417	172.0	224.0	260.0	201.0	0.486	0.633	0.734	0.568
Apr.	147.0	126.0	97.1	170.0	0.359	0.307	0.237	0.415	96.4	96.4	96.3	180.0	0.272	0.272	0.272	0.508
May	21.8	146.0	19.5	13.2	0.053	0.356	0.048	0.032	10.3	115.0	14.7	13.6	0.029	0.325	0.042	0.038
June	22.5	34.3	2.1	2.3	0.055	0.084	0.005	0.005	11.6	17.9	1.2	0.0	0.033	0.051	0.003	0.000
July	2.9	47.1	0.0	-	0.007	0.115	0.000	-	8.1	54.7	0.0	-	0.023	0.155	0.000	-
Aug.	0.0	212.0	0.0	-	0.000	0.517	0.000	-	0.0	121.0	0.0	-	0.000	0.342	0.000	-
Sept.	0.0	114.0	0.0	-	0.000	0.278	0.000	-	0.0	79.6	0.0	-	0.000	0.225	0.000	-
Oct.	0.2	268.0	0.5	-	0.000	0.654	0.001	-	0.0	226.0	0.0	-	0.000	0.638	0.000	-
Nov.	36.2	199.0	37.2	-	0.088	0.485	0.091	-	20.5	107.0	0.0	-	0.058	0.302	0.000	-
Dec.	2.9	422.0	94.4	-	0.007	1.029	0.230	-	5.4	344.0	26.0	-	0.015	0.972	0.073	-
Year	458.3	2571.4	647.7	955.5	1.118	6.272	1.580	2.330	399.8	1955.6	569.2	841.6	1.129	5.525	1.608	2.377

TABLE 3.3: STREAMFLOW SUMMARY (JANUARY 1989 TO JUNE 1992) PITTOCK SUBWATERSHED MAIN OUTLETS

Month	TEST								CONTROL							
	Flow Volume (cubic dam)				Unit Area Flow Volume (cubic dam/ha)				Flow Volume (cubic dam)				Unit Area Flow Volume (cubic dam/ha)			
	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992	1989	1990	1991	1992
Jan.	99.1	162.0	35.9	81.2	0.276	0.451	0.100	0.226	68.0	101.0	63.0	5.9	0.177	0.263	0.164	0.015
Feb.	24.1	200.0	131.0	105.0	0.067	0.557	0.365	0.292	18.0	150.0	112.0	28.1	0.047	0.391	0.292	0.073
Mar.	179.0	247.0	357.0	254.0	0.499	0.688	0.994	0.708	114.0	199.0	412.0	145.0	0.297	0.518	1.073	0.378
Apr.	176.0	59.7	159.0	203.0	0.490	0.166	0.443	0.565	80.2	58.4	184.0	98.9	0.209	0.152	0.479	0.258
May	10.7	71.9	24.1	62.5	0.030	0.200	0.067	0.174	20.0	57.7	40.1	53.2	0.052	0.150	0.104	0.139
June	30.8	3.2	3.5	3.4	0.086	0.009	0.010	0.009	17.9	16.0	18.0	14.0	0.047	0.042	0.047	0.036
July	0.7	26.0	0.5	-	0.002	0.072	0.001	-	7.3	25.5	10.1	-	0.019	0.066	0.026	-
Aug.	0.0	17.0	0.4	-	0.000	0.047	0.001	-	3.3	8.6	6.2	-	0.009	0.022	0.016	-
Sept.	0.0	33.7	0.0	-	0.000	0.094	0.000	-	1.8	6.9	2.8	-	0.005	0.018	0.007	-
Oct.	0.0	182.0	0.0	-	0.000	0.507	0.000	-	0.0	61.8	1.5	-	0.000	0.161	0.004	-
Nov.	20.3	210.0	2.2	-	0.057	0.585	0.006	-	3.2	95.2	0.8	-	0.008	0.248	0.002	-
Dec.	2.8	256.0	18.6	-	0.008	0.713	0.052	-	0.1	178.0	1.2	-	0.000	0.464	0.003	-
Year	543.5	1468.5	732.3	709.1	1.514	4.091	2.040	1.975	333.8	958.1	851.7	345.1	0.869	2.495	2.218	0.899

Figure 3.1: Essex Seasonal Streamflow: 1989-1992

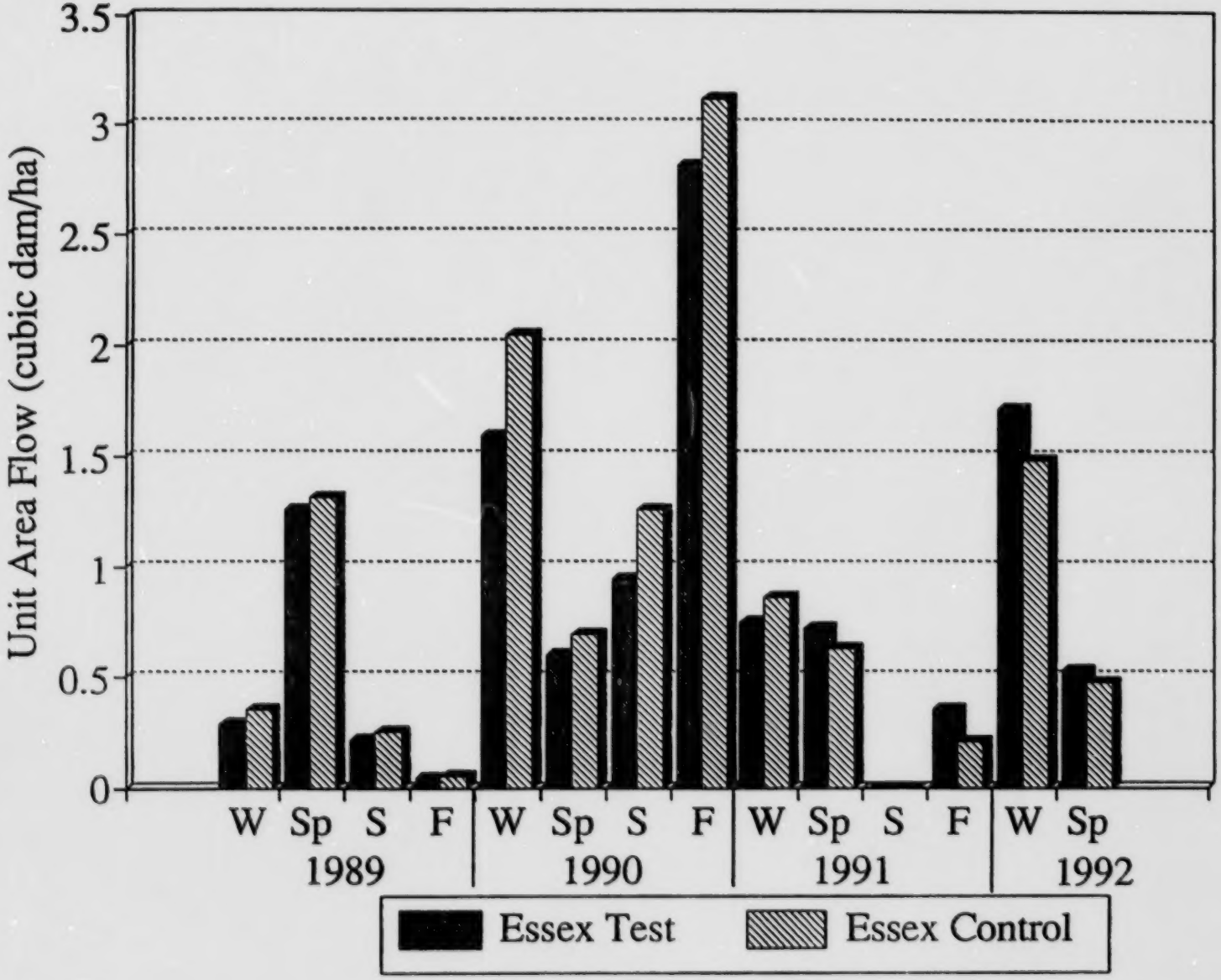
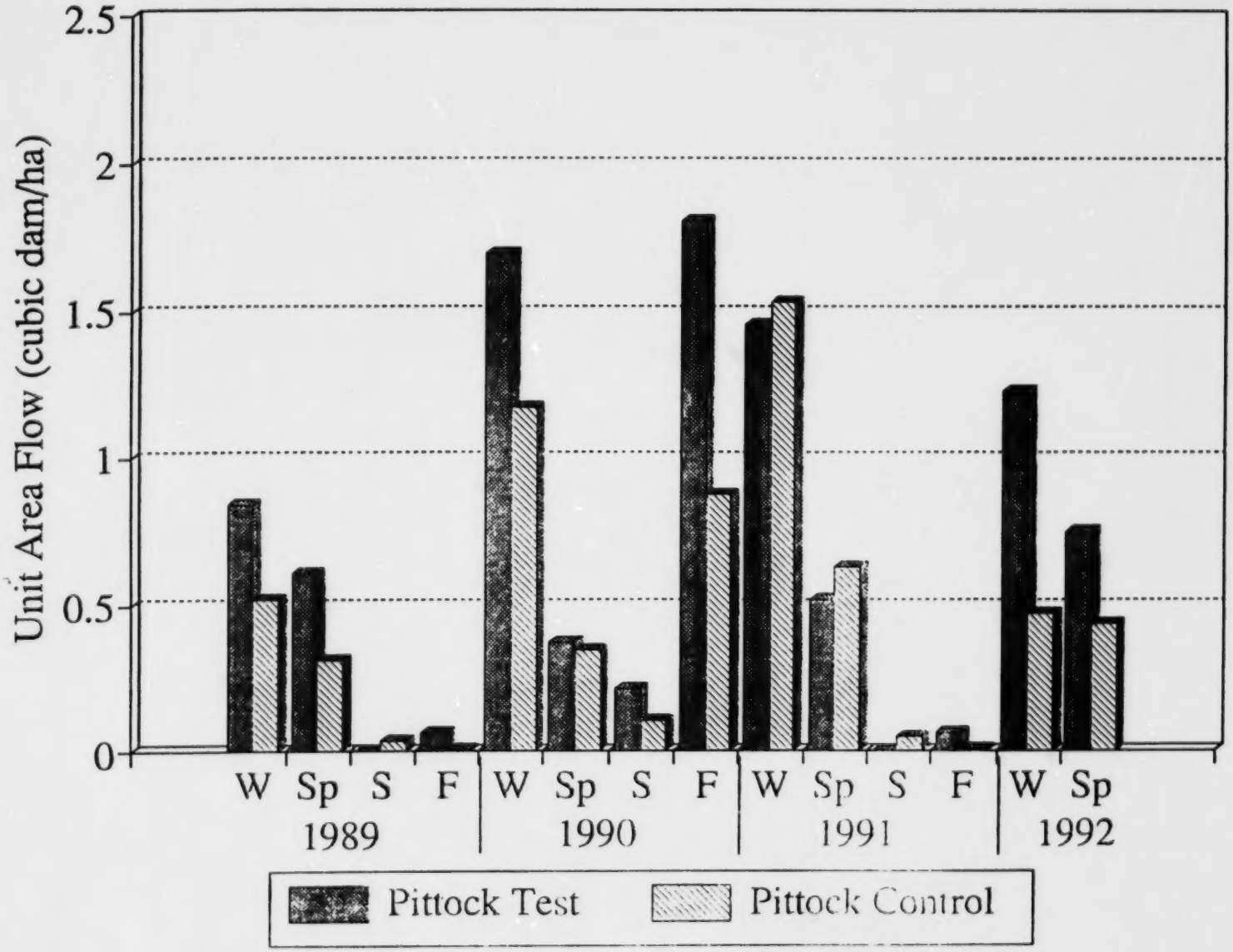


Figure 3.3: Pittock Seasonal Streamflow: 1989-1992



- During a wet year (1990) when precipitation exceeded the normal precipitation by 7 to 41%, the total sub-watershed outflows exceeded that of dry years by three to five times in Essex and Kettle Creek (1989 and 1991 precipitation was from 13 to 41% below the normal levels). Pittock flows in 1990 were up to three times higher than 1989 and 1991 volumes.

Figures 3.4 to 3.6 clearly show the following:

- Runoff is extremely "peaky" at all sites, responding rapidly to precipitation and returning to baseflow almost as rapidly. Changes in flow rate covering several orders of magnitude within hours has been observed at all sites.

- Seasonal trends are apparent in that the highest flow rates (peaks and baseflow) are observed during the March-April period due to snowmelt, rainfall and minimal evapotranspiration at that time. Summer flows are minimal and often drop to 0 as soil infiltration rates and evapotranspiration exceeds precipitation rates and groundwater levels drop below the datum of the drainage channels.

- Runoff from Kettle Creek and Essex sub-watersheds tends to be more "peaky" than the Pittock runoff. Pittock flows, especially Pittock **control** sub-watershed, are sustained longer through very dry periods (summers of 1989 and 1991).

- Essex and Kettle Creek sub-watersheds have responded similarly over the study period while the Pittock sub-watersheds clearly differ during high and low flow periods.

Figures 3.7 to 3.9 display the flow rate distribution for the three watershed pairs in unit area terms for 36 months from 1989 to 1991. Differences in sub-watershed behaviour are highlighted here since both areas received similar precipitation. The Essex **test** sub-watershed had a consistently lower frequency of low unit area flows (<0.5 m^3/hr/ha) than the **control**

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Fig. 3.4 Essex Streamflow (1989-92)

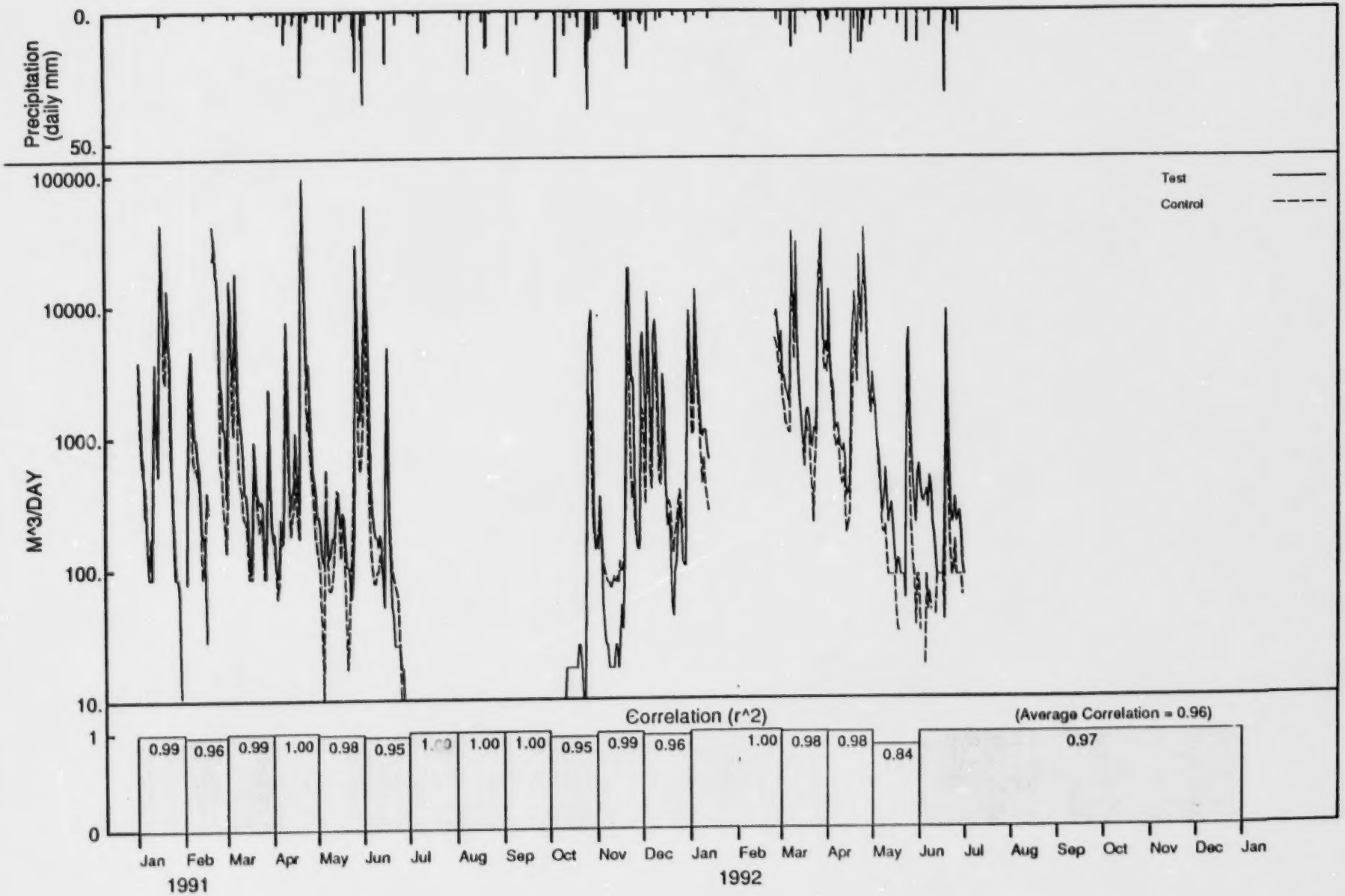


Fig. 3.4 Essex Streamflow (1989-92)

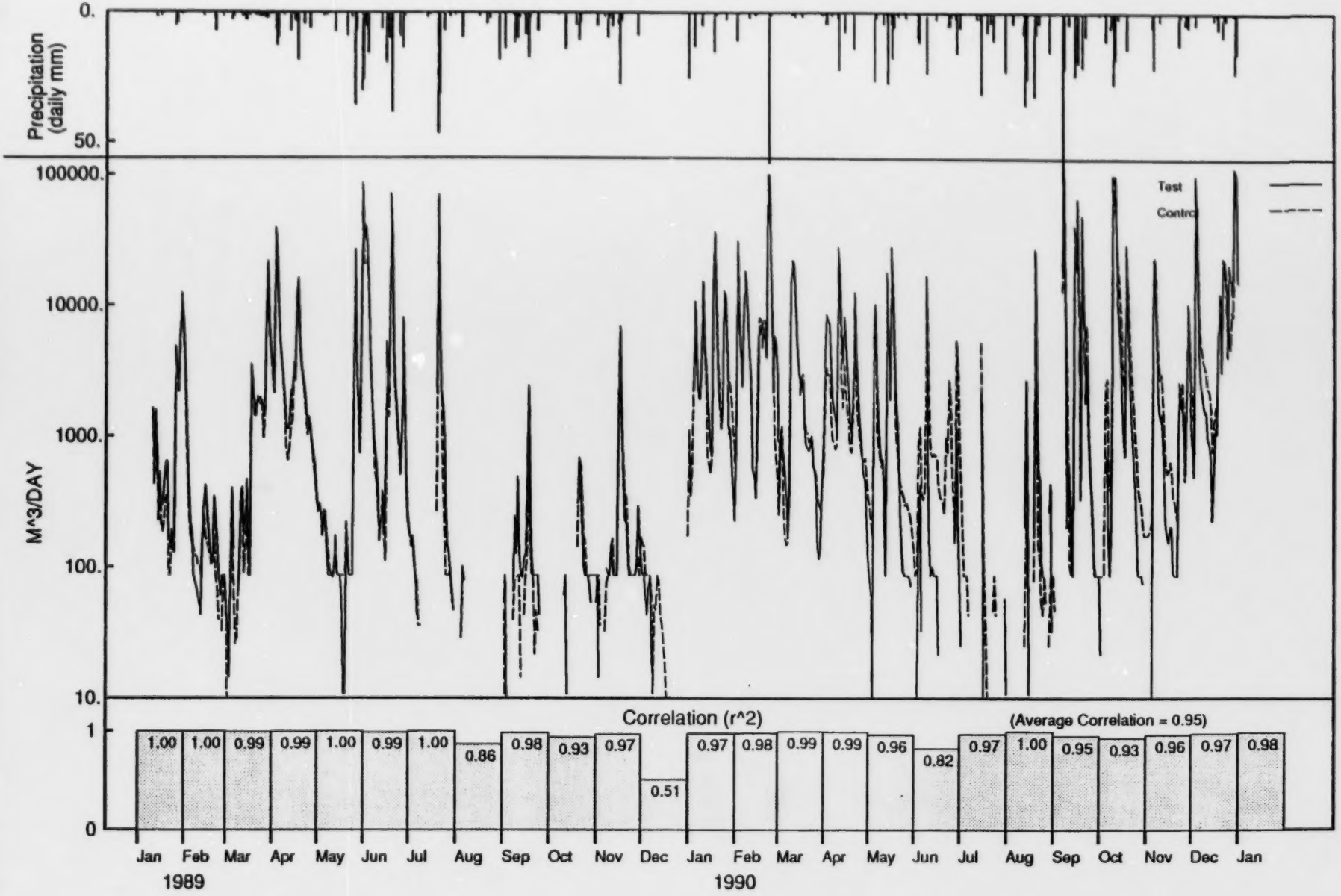


Fig. 3.5 Kettle Ck. Streamflow (1989-92)

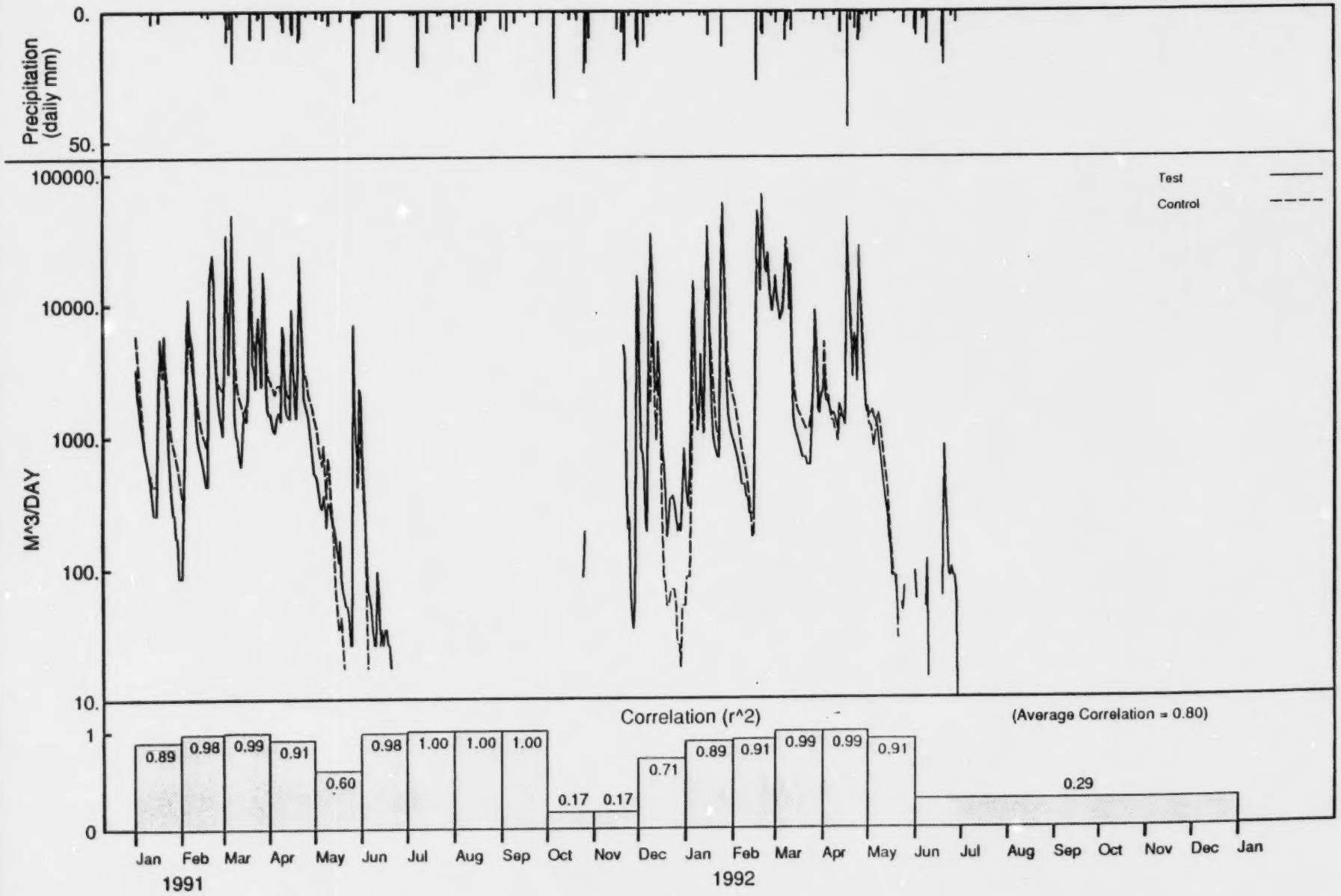


Fig. 3.5 Kettle Ck. Streamflow (1989-92)

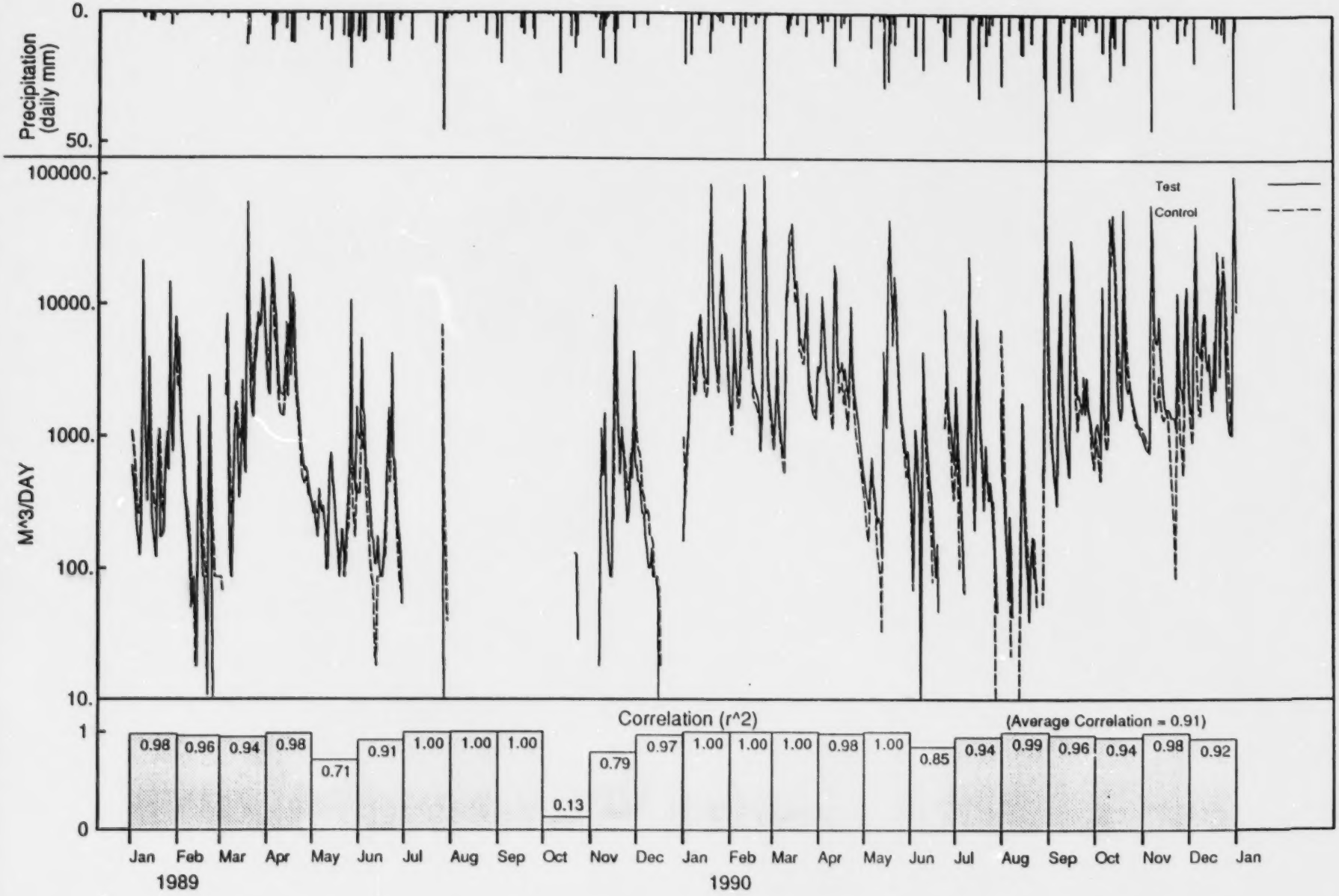


Fig. 3.6 Pittock Streamflow (1989-92)

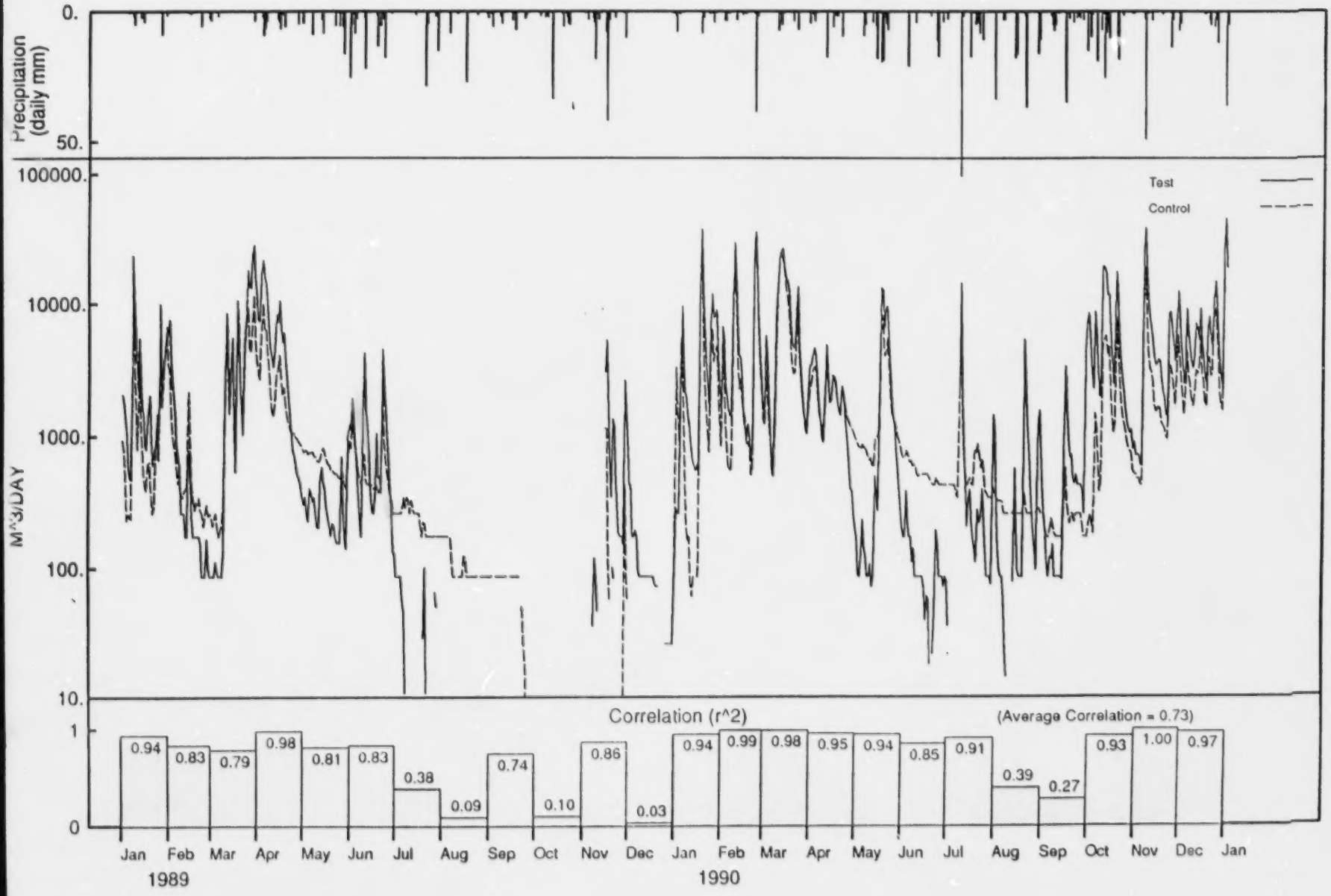


Fig. 3.6 Pittock Streamflow (1989-92)

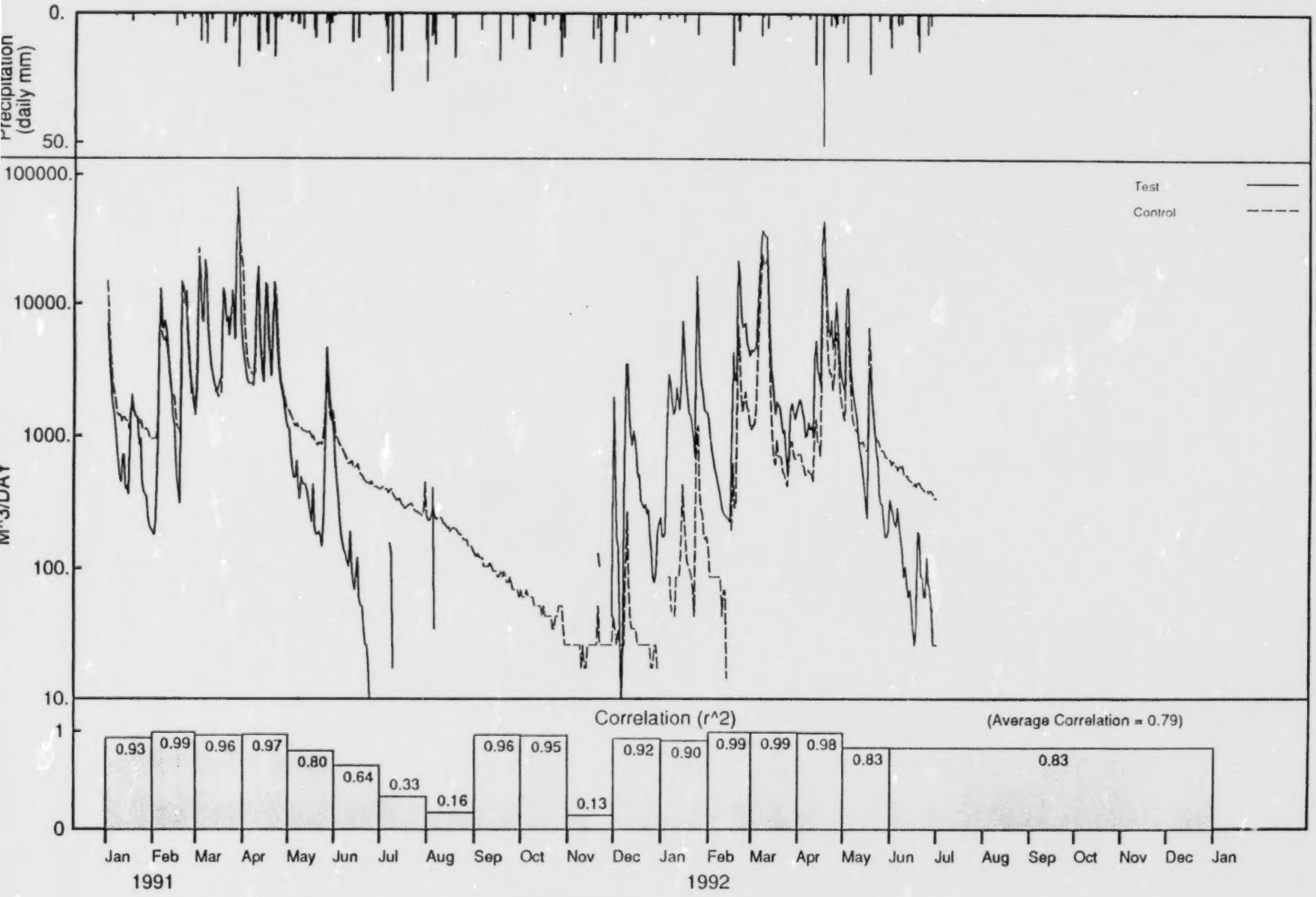


Figure 3.7

Essex Flow Distribution

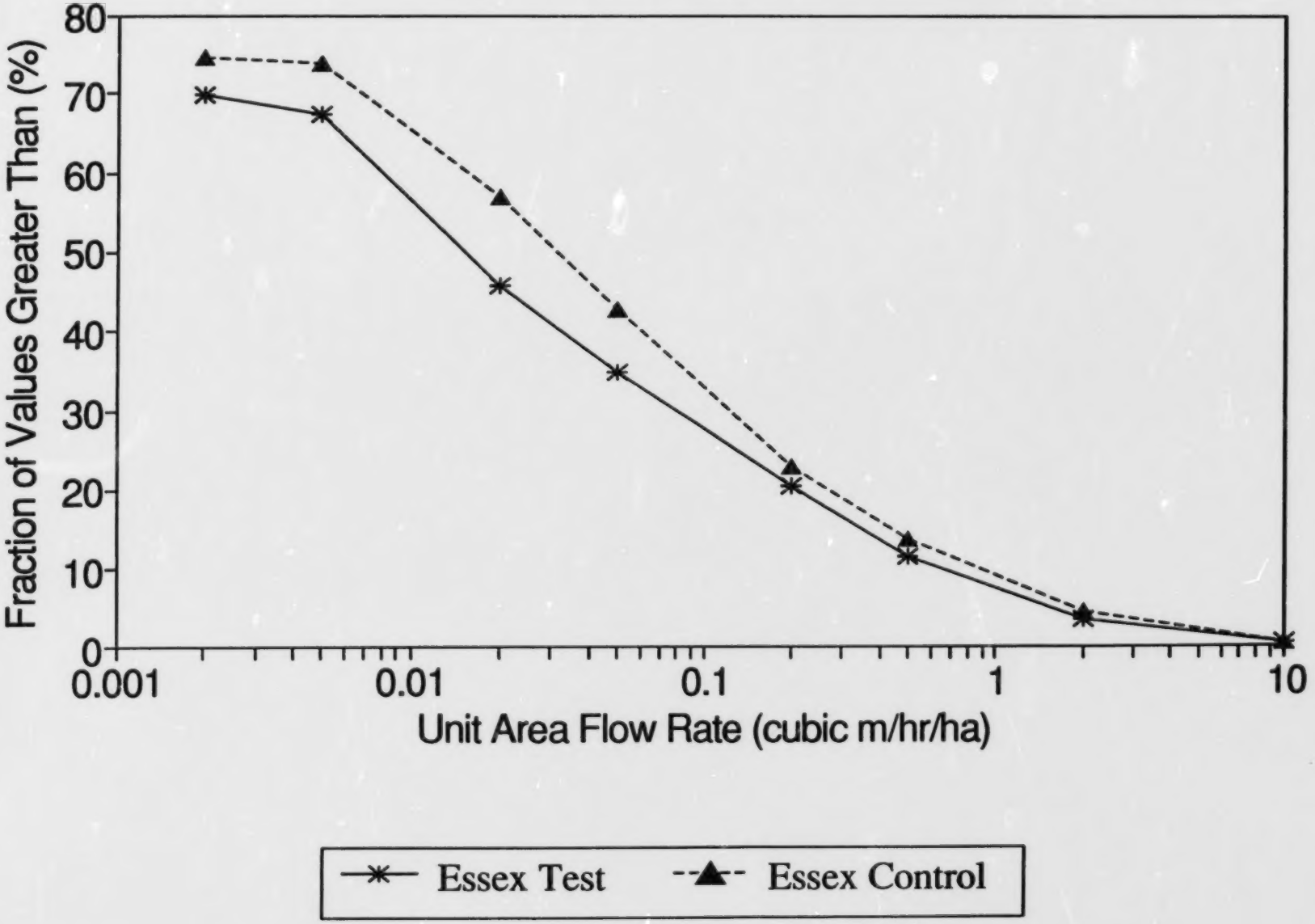


Figure 3.8

Kettle Creek Flow Distribution

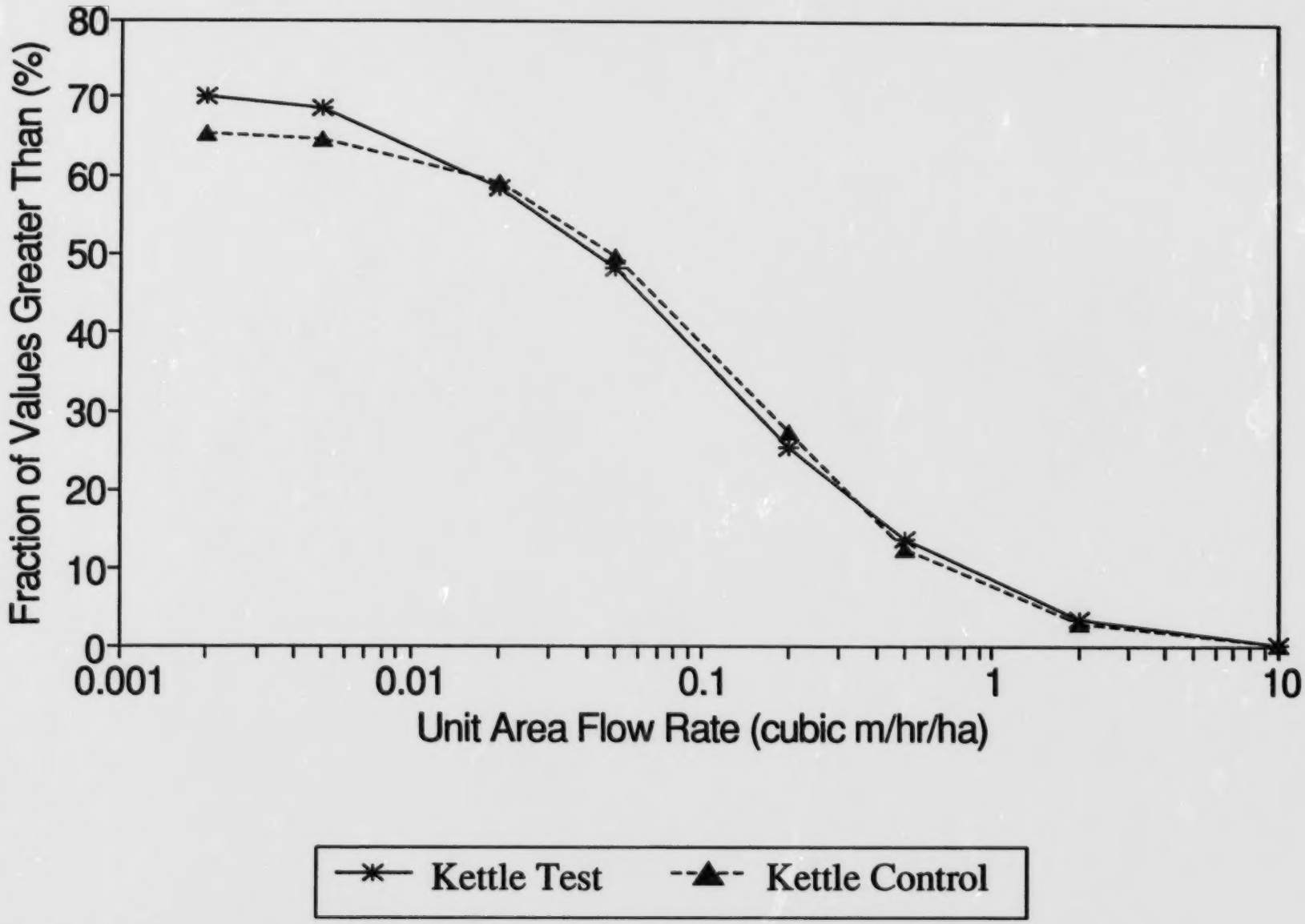
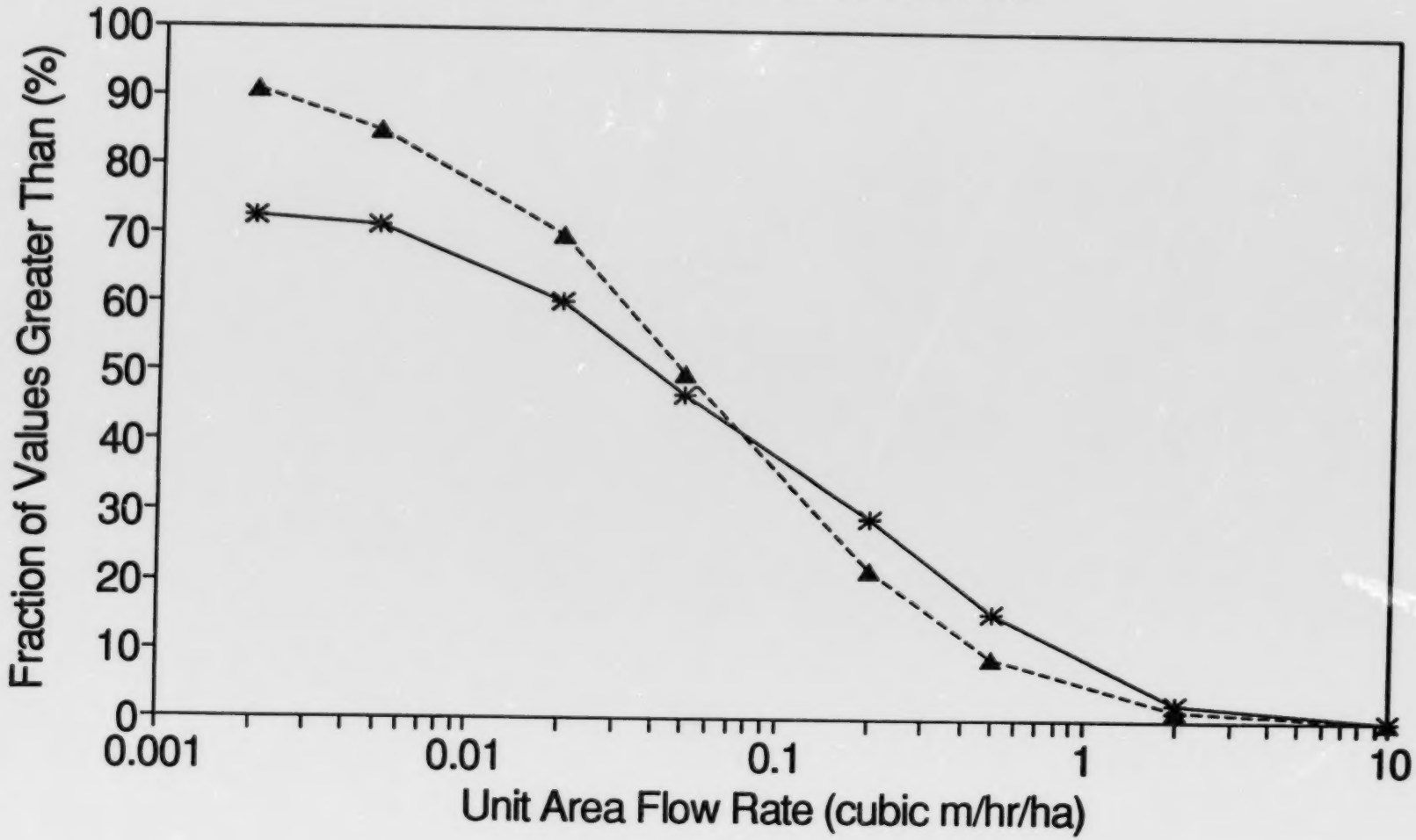


Figure 3.9
Pittock Flow Distribution



sub-watershed although both sub-watersheds had a similar frequency of high flow rates (>2 m^3/hr/ha). The difference noted here is generally more pronounced at the lower flow rate range but is also true at the high flow range. They do differ in terms of baseflow and this may be due to the relative depths of groundwater and the water holding capacity of the vadose zone in the two areas. Since baseflows contribute very little to soil and phosphorus losses, this difference may not be manifested in material losses. At the 50% probability line, Essex **test** had a significantly lower flow reflecting the fact that this sub-watershed has produced less unit area runoff over the study period. These results suggest that Essex **control** has a tendency to more runoff and if all land use patterns were similar then more erosion and material runoff on a unit area basis would likely occur from the **control** watershed.

The Kettle Creek sub-watersheds displayed very similar outflow distributions except in the very low flow range (<0.02 m^3/hr/ha). This correspondence suggests that these watersheds behave similarly in hydrologic terms. Also, these results do not indicate that there is any significant tendency for either watershed to produce a higher loading of soil and phosphorus.

The Pittock sub-watersheds display the most difference. Pittock **test** sub-watershed shows a more "peaky" behaviour with more extreme flows. The 50% flow for the **test** sub-watershed is lower than control indicating that this area has lower overall runoff. These distributions also suggest that Pittock **test** may generate more erosional losses because of the tendency to higher event runoff.

3.1.2 Hydraulic Yields

Tables 3.4 to 3.6 list sub-watershed precipitation, runoff and hydraulic yields by season for the period of study. Hydraulic yield is calculated as the runoff divided by the precipitation input and converted to a percentage. Under normal conditions the hydraulic yield should be less than 100% since hydraulic losses and watershed storage occur to reduce outflow. Losses include the following:

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TABLE 3.4: ESSEX SUB-WATERSHED HYDRAULIC YIELDS

Year	Season[1]	ESSEX TEST			ESSEX CONTROL		
		Precipitation (cubic dam)	Runoff (cubic dam)	Hydraulic Yield (%)	Precipitation (cubic dam)	Runoff (cubic dam)	Hydraulic Yield (%)
1989	Winter[2]	336	125	37.2	217	98.9	45.6
	Spring	1430	549	38.5	924	368	39.8
	Summer	927	90.9	9.81	599	68.8	11.5
	Fall	567	17.3	3.05	366	13.8	3.77
	Annual	2330	782	33.6	1510	550	36.5
1990	Winter	520	695	134	336	577	172
	Spring	1040	261	25.1	672	196	29.2
	Summer	1670	412	24.7	1080	353	32.7
	Fall	907	1230	136	586	878	150
	Annual	4140	2600	62.8	2670	2000	75.1
1991	Winter	90.2	325	360	58.3	243	417
	Spring	932	316	33.9	602	177	29.4
	Summer	444	0.00	0.00	287	0.00	0.00
	Fall	988	153	15.5	638	58.4	20.3
	Annual	2450	794	32.4	1580	478	30.3
1992	Winter	486	747	154	314	416	132
	Spring	795	230	28.9	514	135	26.3
1989-92	TOTAL	11130	5150	46.3	7190	3580	49.8

[1] Seasons are as follows: Winter - January to March; Spring - April to June; Summer - July to September; Fall - October to December

[2] Winter of 1989 begins on January 10

TABLE 3.5: KETTLE CREEK SUB-WATERSHED HYDRAULIC YIELDS

		KETTLE CREEK TEST			KETTLE CREEK CONTROL		
Year	Season	Precipitation (cubic dam)	Runoff (cubic dam)	Hydrualic Yield (%)	Precipitation (cubic dam)	Runoff (cubic dam)	Hydraulic Yield (%)
1989	Winter	195	225	115	168	192	114
	Spring	950	191	20.1	820	118	14.4
	Summer	629	2.90	0.46	543	8.10	1.50
	Fall	687	39.3	5.70	593	25.9	4.40
	Annual	2460	458	18.6	2120	344	16.2
1990	Winter	732	1000	137	632	794	126
	Spring	971	306	31.5	838	229	27.3
	Summer	1700	373	21.9	1470	255	17.3
	Fall	1065	889	83.5	920	677	73.6
	Annual	4470	2570	57.5	3860	1955	50.6
1991	Winter	335	397	119	289	431	149
	Spring	605	119	19.7	522	112	21.5
	Summer	488	0.00	0.0	421	0.00	0.00
	Fall	800	132	16.5	691	26.0	3.80
	Annual	2230	648	29.1	1925	569	29.6
1992	Winter	474	770	162	409	648	158
	Spring	747	186	24.9	645	194	30.1
1989-92	TOTAL	10380	4630	44.6	8960	3710	41.4

TABLE 3.6: PITTOCK SUB-WATERSHED HYDRAULIC YIELDS

Year	Season	PITTOCK TEST 359			PITTOCK CONTROL 384		
		Precipitation (cubic dam)	Runoff (cubic dam)	Hydrualic Yield (%)	Precipitation (cubic dam)	Runoff (cubic dam)	Hydraulic Yield (%)
1989	Winter	164	302	184	175	200	114
	Spring	778	218	28.0	832	118	14.2
	Summer	440	0.70	0.16	471	12.4	2.60
	Fall	627	23.1	3.70	671	3.30	0.49
	Annual	2010	544	27.1	2150	334	15.5
1990	Winter	381	911	239	408	450	110
	Spring	726	135	18.6	777	132	17.0
	Summer	1270	76.7	6.00	1360	41.0	3.00
	Fall	980	648	66.1	1050	335	31.9
	Annual	3360	1470	43.8	3590	9585	26.7
1991	Winter	329	524	159	352	587	167
	Spring	567	187	33.0	606	242	39.9
	Summer	696	0.90	0.13	744	19.1	2.60
	Fall	538	20.8	3.90	575	3.50	0.61
	Annual	2130	732	34.4	2280	852	37.4
1992	Winter	237	440	186	254	179	70.5
	Spring	729	269	36.9	780	166	21.3
1989-92	TOTAL	8460	3760	44.4	9060	2490	27.5

- increases in watershed soil moisture,
- evapotranspiration,
- losses to deep groundwater, and
- groundwater withdrawals.

Often during the winter period (January to March) snowmelt occurs from snow which accumulated during the October to December period of the previous year. This results in falsely elevated hydraulic yields during this period, often forcing hydraulic yield above 100%. There is a corresponding false low yield for the preceding season in this case. Errors in measuring snowfall and precipitation can also affect these estimates. Snowfall measurement is particularly fraught with error. Generally snowfall is underestimated, resulting in elevated hydraulic yield estimates during winter periods.

Despite these errors and carry-overs, hydraulic yield is a useful factor for comparing watersheds between seasons and between locations.

From Table 3.4 the following observations are presented for Essex **test** and **control** watersheds:

- annual hydraulic yields are low (<37%) in the dry years of 1989 and 1991;
- annual hydraulic yield is high (63 to 75%) for the wet year, 1990;
- **test** and **control** sub-watersheds compare closely throughout the period of record reflecting similar drainage characteristics;
- the most significant differences occurred during the winter seasons;

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- the winter hydraulic yields exceeded 100% in both sub-watersheds in 1990, 1991 and 1992;

- both **test** and **control** sub-watershed experienced a 0% hydraulic yield in the summer of 1991 as over 100 mm of observed precipitation was lost to evapotranspiration, temporary plant and soil storage, and deep groundwater;

- if actual evapotranspiration is assumed to be about 0.53 m per year for Essex (Brown *et al.*, 1968) then evapotranspiration could account for all of the hydraulic losses;

- seasonal patterns are consistent throughout with high yields in winter due to snowmelt and low evapotranspiration losses, springtime yields of about 30%, summer yields ranging from 0 to 33% and averaging 13%, and fall yields of about 55% with wide variation.

The Kettle Creek Sub-watersheds (Table 3.5) display similar trends to Essex. The following observations are presented:

- annual hydraulic yields are very low (<30%) during the two driest years, 1989 and 1991;

- annual hydraulic yields are high (50.6 to 57.5%) during the wet year, 1990;

- **test** and **control** sub-watersheds compare closely throughout the period of record reflecting similar hydraulic characteristics;

- seasonal patterns are somewhat inconsistent throughout with winter yields in excess of 100%, spring yields are modest ranging from 14.4 to 31.5%, summer yields vary widely from 0% during the driest summer to 21.9% during the wet summer of 1991, and fall varying widely from 3.8 to 83.5%;

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- both **test** and **control** sub-watersheds experienced 0% hydraulic yields in 1991 and very low values in 1989 under lower than normal precipitation; and

- evapotranspiration can account for all of the hydraulic losses in these sub-watersheds.

The Pittock sub-watersheds (Table 3.6) display somewhat more disparity between sub-watersheds. The following comments are presented:

- annual hydraulic yields are very low during the dry years of 1989 and 1991 ranging from 15.5 to 37.4%;

- annual hydraulic yields are modest at 26.7 to 43.8% during 1990, the wettest year;

- Pittock **test** sub-watershed has generally higher yields than **control** with total period average in **test** exceeding **control** by over 60%;

- hydraulic yields were similar in 1991 in both sub-watersheds but differ greatly in other periods where the **test** yields are almost double the **control** yields; and

- evapotranspiration could account for all of the hydraulic losses, however, since they differ so much from **test** to **control**, it is likely that more water enters deep groundwater system from the test watershed and represents a net water loss that does not occur in the **control** watershed.

3.1.3 Effects of Cover on Runoff

Researchers are divided on the question of how conservation tillage affects surface runoff. In the U.S. it is generally believed that conservation tillage reduces surface runoff. It is felt that plant residue impedes surface runoff, provides increased surface water detention, results

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in stable macropores and worm burrows, reduces compaction thus increasing porosity, and it allows more time for infiltration. Canadian researchers have documented cases of increased surface runoff from fields with high residue levels. Some of the speculation for this phenomenon includes the fact that surface soil moisture levels are higher with high residue thus reducing infiltration rates, freeze-thaw cycles may create localized lenses of low permeable zones within the soil matrix, and surface sealing may be enhanced and maintained by reduced tillage. Clearly, generalizations on this interrelationship may be impossible and are beyond the scope of this study. The study design employed here does not allow for detailed investigation of the mechanisms which affect runoff, but watershed scale observations have been related to one measure of conservation tillage, live and dead cover. Live and dead cover is a useful general parameter which relates directly to the degree of conservation tillage implemented as well as several other soil parameters such as surface soil moisture and roughness. Cover may be inversely related to surface detention, storage and infiltration.

Table 3.7 identifies the generalized cover patterns (live and dead) for fifteen common crop and land use types. This table has been developed based upon cover measurements made three times annually at several sites in the watersheds and documented in Report #4. From this information and cropping information provided by cooperators a table of seasonal cover has been developed for each sub-watershed (see Table 3.8) by season. These represent the best available estimate of total average sub-watershed cover by season. Table 3.8 shows that in terms of cover, Essex and Kettle Creek **test** sub-watersheds have been steadily improving over the period of study. In Pittock a trend to improvement in the **test** sub-watershed in 1990 was reversed in 1991.

In order to investigate the effect of cover on runoff, the ratio of total seasonal unit area outflow from the **test** sub-watershed to the **control** sub-watershed (TQ/CQ) was correlated to the ratio of cover for the **test** sub-watershed to the **control** sub-watershed (TC/CC) on a seasonal basis for the period 1989 to March of 1992. Winter periods (January to March) were excluded due to the confounding effect of snow. This type of comparison recognizes that

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Table 3.7: Generalized PWS Cover (% Live and Dead) Patterns by Month and Crop-Tillage System

Month		Jan	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Corn:	Conventional	7.5	7.5	7.5	7.5	15	40	80	100	100	70	8	8
	Reduced Till	31	29	26	23	30	60	85	100	100	75	33	32
	No Till	87	85	82	80	85	90	95	100	100	100	88	87
Winter Wheat:	Conventional	8	8	8	10	55	100	80	7	7	7	8	8
	Reduced Till	35	35	35	45	70	100	85	38	38	35	35	35
	No Till	88	85	80	85	90	100	90	80	80	85	90	90
Beans:	Conventional	9	9	9	9	15	35	65	80	100	50	9	9
	Reduced Till	30	30	30	30	35	50	80	90	100	60	30	30
	No Till	75	75	70	69	75	80	90	95	100	90	80	80
Spring Grain:	Conventional	8	8	8	8	20	45	80	100	100	8	8	8
	Reduced Till	28	28	28	28	35	55	90	100	100	28	28	28
	No Till	90	89	88	87	95	100	100	100	100	92	92	91
Fallow		5	5	5	5	5	5	5	5	5	5	5	5
Bush/Buildings		70	70	70	80	95	95	95	95	95	95	80	70
Idle/Pasture		95	95	95	95	95	95	95	95	95	95	95	95

Table 3.8: Watershed Scale Average Cover (% Live & Dead) By Season

		ESSEX		KETTLE CREEK		PITTOCK	
		Test	Control	Test	Control	Test	Control
1989	Winter	22.5	20.2	31.9	28.7	35.5	34.1
	Spring	37.6	37.1	44.6	43.8	48.7	46.1
	Summer	81.9	79.2	85.7	78.4	89.2	92.8
	Fall	33.9	31.7	4.5	38.4	46.8	47.8
	1989 Average	44.0	42.1	51.7	47.3	55.1	55.2
1990	Winter	24.6	18.2	42.4	28.6	37.8	25.5
	Spring	41.9	37.5	54.4	44.5	47.8	34.0
	Summer	77.7	77.1	87.4	84.3	87.9	84.3
	Fall	34.6	30.1	53.4	41.0	49.6	38.7
	1990 Average	44.7	40.7	59.4	49.6	55.8	45.6
1991	Winter	28.0	17.9	48.2	24.2	31.7	29.9
	Spring	37.8	32.1	59.1	36.4	43.9	44.1
	Summer	87.5	85.3	89.0	90.9	90.7	89.9
	Fall	40.6	32.6	58.3	39.9	45.4	43.0
	1991 Average	48.5	42.0	63.7	47.9	52.9	51.7
1992	Winter	30	19	50	27	35	30

Figure 3.10: RATIO OF TEST AND CONTROL FLOW (TQ/CQ) VS COVER (TC/CC) ESSEX

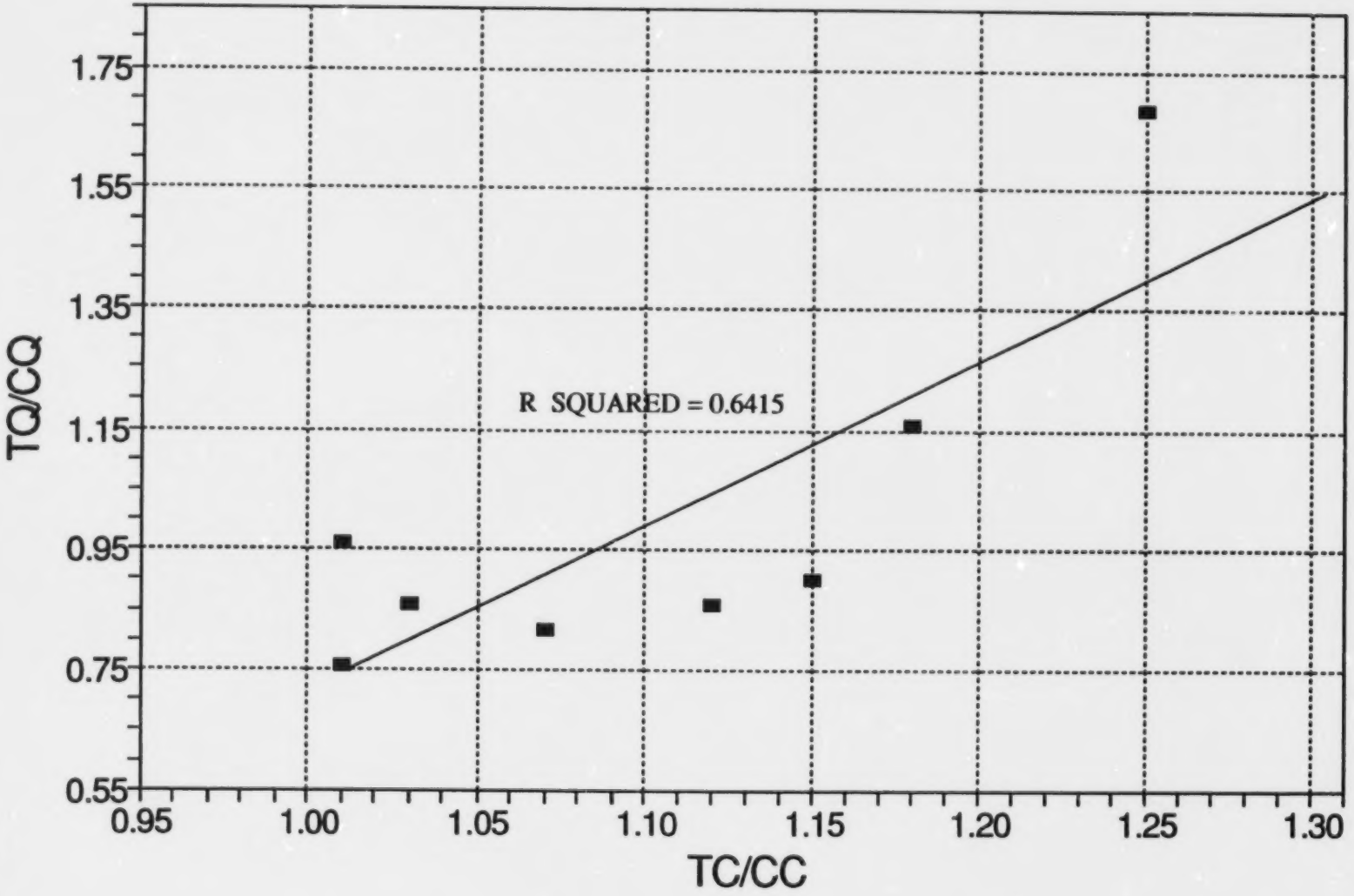


Figure 3.11: RATIO OF TEST AND CONTROL FLOW (TQ/CQ) VS COVER (TC/CC) KETTLE CREEK

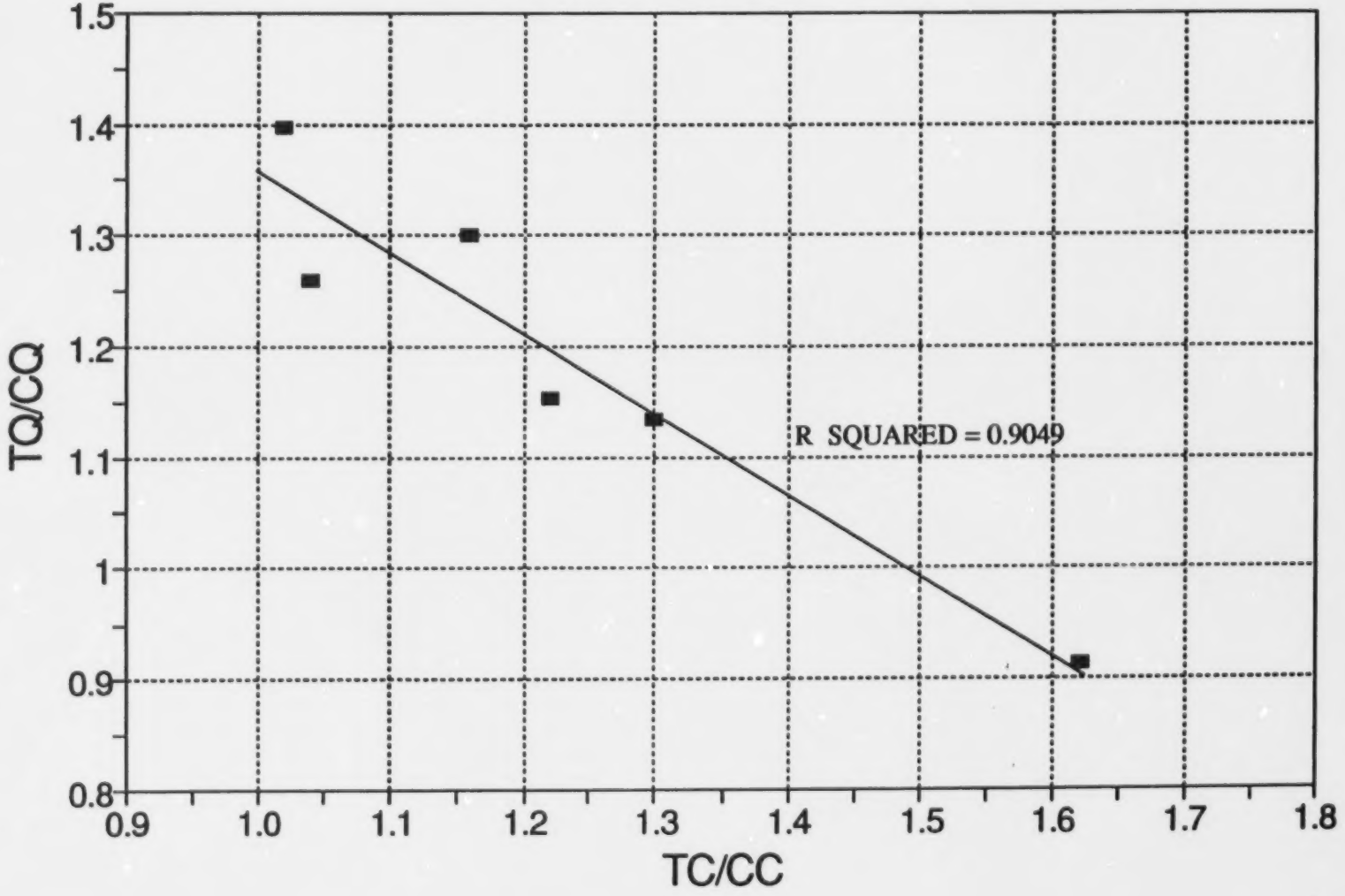
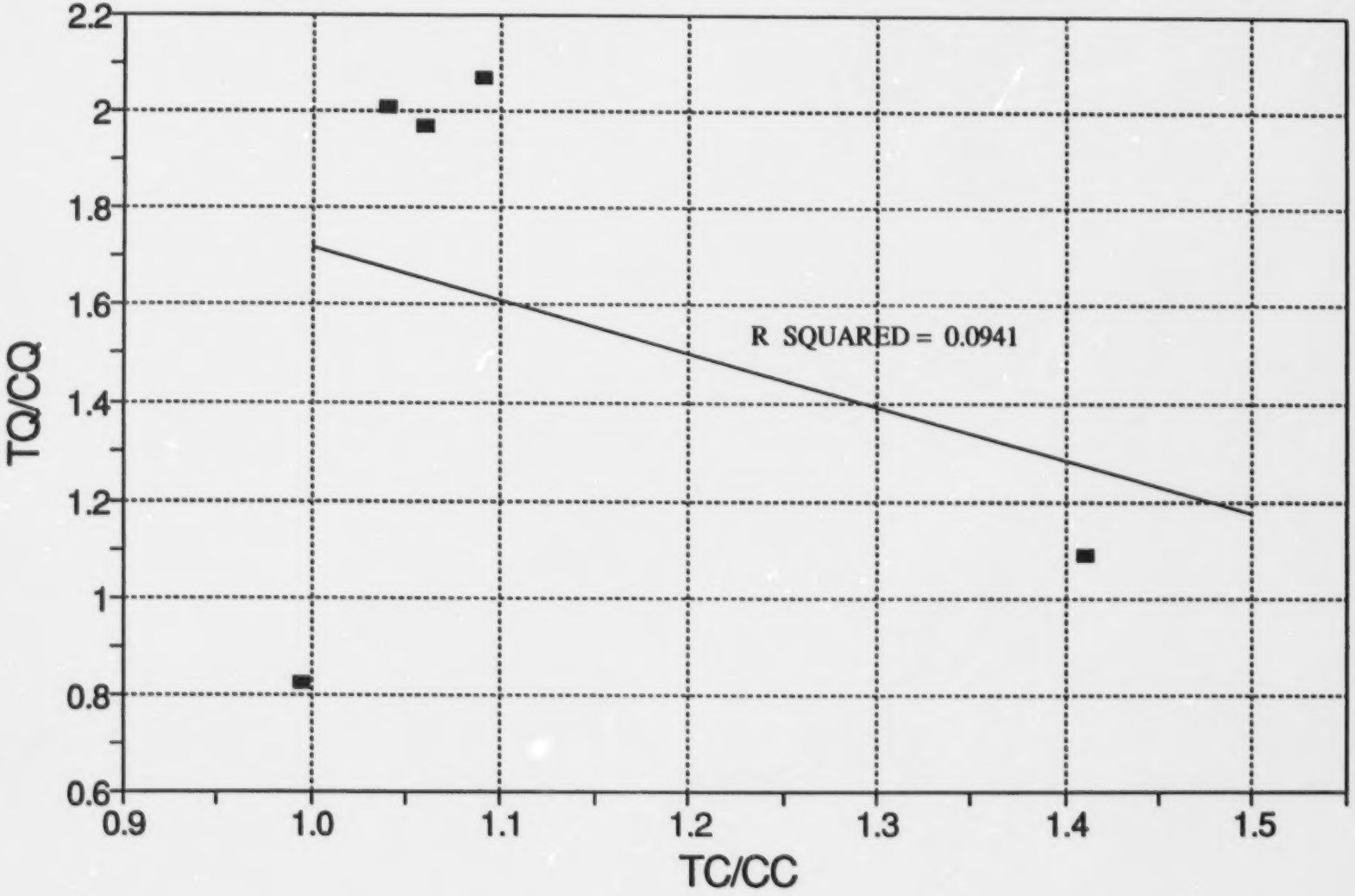


Figure 3.12: RATIO OF TEST AND CONTROL FLOW (TQ/CQ) VS COVER (TC/CC) PITTOCK



assessment of trends. Figures 3.10 to 3.12 present the results of a linear regression performed between TQ/CQ and TC/CC.

In Essex, a reasonable positive correlation was achieved between flow and cover. This indicates that as cover continued to increase in the **test** sub-watershed relative to the **control** sub-watershed the unit area flows responded positively. This could account for the trend observed in this watershed which showed that unit area flows exceeding **control** only in the last five seasons monitored.

Explanations for this phenomenon could include more surface sealing and higher soil moisture leading to lower surface infiltration under conservation tillage.

The reverse trend is apparent in Kettle Creek where increased cover is negatively related to seasonal runoff. This could explain the fact that while **test** unit area flow tended to exceed **control** unit area flow, a reversal did occur towards the later seasons of the study when **test** cover levels had increased substantially. Explanations for this phenomenon could include the fact that increased cover impedes runoff allowing for more infiltration and sustains macroporosity, common in cohesive soils and due to worm burrows.

No clear trend is apparent in Pittock. In this watershed fewer seasons produced significant runoff. Depending upon which of the outlying data points is removed the trend could be in either direction. More data is required in this case to improve the correlation analysis. The biggest differences in cover between the Pittock sub-watersheds was in 1990 when the unit area flows for the **test** sub-watershed exceeded the **control** by the largest percentage. This suggests that the relationship between flow and cover here is positive.

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inherent differences exist in sub-watershed behaviour within each pair and allows for an assessment of trends. Figures 3.10 to 3.12 present the results of a linear regression performed between TQ/CQ and TC/CC.

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3.2 Microbasins

3.2.1 Background

The microbasin monitoring program was designed to allow for field level runoff and water quality loading analysis. This is the intermediate scale of monitoring in this study with microbasin areas ranging from 4.1 to 28.0 ha (about 1 to 8% of sub-watershed areas). The data from the microbasin level monitoring provides for comparison of areas consisting of one to five fields therefore involving much less complexity than the entire watershed scale in terms of land use, soil types and drainage.

Given the size and slope of the these microbasins; the frequency, duration and variable distribution of precipitation; and the rapid flow response time not all microbasins produce runoff and associated water quality loadings as regularly as do the main watershed outlets. The microbasin scale does not measure groundwater runoff and is almost totally due to surface overland flow. A number of other factors such as monitoring equipment failure, high flow backwater effects and occasionally, flooding of monitoring equipment, has further reduced the accuracy of some flow events at this scale. Due to these factors and the variability of precipitation, total flows are not necessarily comparable from microbasin to microbasin within a watershed for the entire yearly duration.

3.2.2 Microbasin Runoff

As described above, not all microbasins produced flow events on a regular basis nor did they produce concurrent flow during all precipitation events. Some microbasins would respond to precipitation more readily than others as is documented in Tables 3.9 which summarizes the number of events monitored by microbasin over the course of the study. Tables 3.10 through to 3.12 contain selected representative microbasins flow events. Those omitted here produced insignificant amounts of flow or exceeded the design capacity of the flow measurement systems. Appendix B contains all microbasin event runoff data.

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TABLE 3.9: NUMBER OF MICROBASIN EVENTS BY YEAR

Year	ECB1	ECB2	ETB1	ETB2
1989	1	1	1	1
1990	4	10	11	7
1991	1	7	4	1
1992	2	2	1	0
TOTAL	8	20	17	9
	KCB1	KCB2	KTB1	KTB2
1989	0	0	0	0
1990	28	31	10	13
1991	14	14	9	8
1992	9	9	3	4
TOTAL	51	54	22	25
	PCB1	PCB2	PTB1	PTB2
1989	0	0	0	0
1990	8	5	4	14
1991	4	4	8	8
1992	2	5	5	7
TOTAL	14	14	17	29

Note: Due to equipment malfunction, approximately 6-8 events were not reportable.

Over the study period, the Kettle Creek microbasins generated flow most frequently, particularly the **control** basins which ranged from 51 to 54 events. The Kettle Creek **test** microbasins total number of events ranged from 22 to 25. Pittock microbasin events although often minor in nature did range from 14 to 29 in both the **test** and **control** microbasins. Essex microbasin events were quite variable with the total number of events in the **test** basins ranging from 8 to 20 while the **control** ranged from 9 to 17 over the study period.

Generally, Essex and Kettle Creek microbasins would respond quite readily to significant rainfall events during non-draught periods (periods with precipitation within the ten days prior). Naturally all microbasins produced the largest number of single flow events in 1990, the wettest year of the study. Other years produced very few flow·events particularly 1989 (no substantial events were recorded in Pittock or Kettle Creek). The first six months of 1992 generally produced lower than normal precipitation and therefore relatively few microbasin flow events.

Even during periods of moderate precipitation, the microbasins would rarely produce similar unit area flows as shown in Tables 3.10 to 3.12. For example in Essex a 22.5 mm rainfall in April (10-12, 1990) yielded event flows of 3.39 m^3/ha in ECB1, 3.05 m^3/ha in ECB2, 21.04 m^3/ha in ETB1, and 1.42 m^3/ha in ETB2. A similar event of 23.3 mm in May (16-18, 1990) produced the following microbasin flows: 0.00 m^3/ha in ECB1, 29.32 m^3/ha in ECB2, 27.77 m^3/ha in ETB1 and 13.51 m^3/ha in ETB2. Variable results such as these are typical for this scale of monitoring as these field sized areas are heavily influenced by on-field activities, physical factors (shape, slope and roughness), and antecedent conditions. For example, the May event had been preceded with a 23.63 mm precipitation event three days earlier while the April flow event did not receive significant precipitation for the 7 day antecedent period. Additionally, the bulk of microbasin ECB1 had been disced between events and most of the precipitation that fell in the May event infiltrated into the tilled soil resulting in no surface runoff. Portions of the two **test** microbasins (ETB1, ETB2) had been cultivated between events but this did not affect runoff in the same way that the discing had.

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Generally these observations hold true for other watershed microbasins as well. It should be noted that while there is variability in flow events in these microbasins some trends do exist. Based on the limited data (January 1990 to June 1992), the **test** microbasins often produced the most uniform unit area event flows (less variable than the **control**) over the year. The tillage that occurs in the **control** microbasins in the fall and spring results in a more permeable soil over a short period (up to one month). This results in less runoff from these tilled **control** microbasins during these periods. This in turn results in more variable unit area flow events from these **control** microbasins. This phenomenon is confirmed by plot scale studies discussed in Section 3.3.

Overall, unit area flow events at the microbasin scale were highest in Kettle Creek and lowest in the Pittock watershed. Typical unit area flows in Kettle Creek microbasins were in the 20 (KCB1) to 100 (KTB1) m^3/ha per day and maximum daily unit area event flows of approximately 350 (KCB2 and KTB2) to 1000 (KTB1) m^3/ha. Typical unit area daily flows in the Essex microbasins were 10 (ECB1) to 25 m^3/ha (ECB2 and ETB1) while maximum daily flows were 15 (ECB1) to 225 (ECB2) m^3/ha. Pittock produced the lowest unit area flows overall. It also produced the most variability between **test** and **control** microbasins. Typical average unit area flows in Pittock microbasins ranged from about 1 (PCB1) to 35 m^3/ha (PTB2).

Generally, the **test** microbasins produced the higher average and maximum unit area flows (exceptions were ECB2 and to a lesser extent KCB1) although this observation is not statistically significant. This is in agreement with the findings of other studies that unit area flow volumes are often higher from no-till lands, especially during the non-growing season.

3.2.3 Effects of Cover Upon Runoff

In order to evaluate the effect of live and dead cover, and therefore the tillage program, on microbasin runoff a series of statistical tests were conducted. All microbasin total event

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outflow was converted to unit area runoff. Furthermore, the LS factor (Wischmeier and Smith, 1978) was estimated for each microbasin and all unit area event flows were divided by LS in order to normalize microbasins to account for differences in slope and slope length. Multivariate analyses were performed wherein the normalized unit area event flow was the dependent variable and the independent variables included live and dead cover, soil moisture, event precipitation volume and antecedent precipitation. Cover was estimated from actual measured cover and interpolation for non-measurement periods. Tests were conducted with all microbasins within a watershed lumped and individually in a non-normalized form. Precipitation volume was the most significant parameter but this factor was not significant in many tests.

The lumped analysis did not identify the significance of cover upon runoff suggesting that the normalization technique used is not capable of accounting for microbasin size and shape differences.

Cover was a significant factor (at an 86% or higher confidence level) in five microbasins in an unlumped analysis. In the five cases wherein cover was a significant factor, four displayed a positive relationship between cover and outflow (ECB2, ETB1, ETB2 and KCB1) with an average confidence level of 95%. The three Essex microbasins identified here confirm the watershed scale evaluation that indicated the positive relationship between flow and cover.

PTB2 was the sole microbasin which indicated a negative relationship between cover and flow, at a 99% confidence level. Four other microbasins displayed no significant correlation between cover and flow and three microbasins had insufficient data to perform multivariate analysis.

At this scale, several factors could confuse and mask the effects of tillage such as differences in precipitation volume and intensity between microbasins during the same event; localized soil moisture differences; the timing of field operations; and crop differences. It is anticipated

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that the correlations examined here would improve with a larger database and a longer history of conservation implementation. Another means to identify the effects of cover at this scale is to compare runoff from different yet similar events for the same microbasin when cover is dissimilar and other factors such as soil moisture, precipitation and crop type are similar or the same. The current database does not allow for this type of analysis.

3.3 Rainfall Simulation

3.3.1 General

Rainfall simulation measurements allow for the most direct comparison between plots and between seasons because of the controlled nature of the test.

As mentioned in Section 2.3, every effort was made to select rainfall simulation sites which were as similar as possible in terms of soils, topography and management practice yet still permitted access for rainfall simulation equipment. Since it was not always possible to select sites which exhibited similar characteristics, crop type was deemed to be the most important factor. Differences which did exist between the **test** and **control** sites were quantified to aid in the interpretation of the data.

Site Characteristics

Soils at both of the Essex sites were clay loams. The Kettle Creek **test** site was also a clay loam soil while the control site was a silt loam. The Pittock **test** sites were situated on silt loam soils while the **control** sites were on loam soils. Although there appear to be some differences between **test** and **control** textures, the sand, silt and clay contents are quite similar for each pair and have only been classed differently because one soil lies just on the other side of the texture boundary in the soil texture triangle (see Beak Consultants Limited, 1991).

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Characteristics of the rainfall simulation sites including management practice, residue cover, slope and antecedent moisture content are summarized in Table 3.13. Results in this table are the mean values for the three replicates. Individual data are found in Appendix C.

Ideally, the crop residue cover percentages would be significantly different between sub-watershed pairs for all seasons except for post harvest 1991 (PH91). Since PH91 occurs after harvest prior to fall tillage, the conservation site has generally similar residue to the conventional site except for some differences in plant population and yield. As identified in Table 3.13, no significant differences in cover are noted for Kettle Creek and Pittock for the PH91 runs but a significant difference is noted in the Essex watershed. However, the Essex sub-watershed pairs are very similar with 54 and 67 percent cover for the **test** and **control** sub-watersheds respectively. Due to the low variance within the replications, these numbers were not statistically different. Also noted in Table 3.13, the Pittock sub-watershed pairs measured in the fall post tillage 1990 period (PT90) show no significant difference in residue cover. This indicates that the modified moldboard plow did not result in a higher residue left on the surface after tillage when compared to the moldboard plow in this case.

Similar slopes between the **test** and **control** sites were desirable but not always feasible as is evident in Table 3.13. However, the effect of slope over only a 1 m distance is not expected to be large. The fact that many of the pairs exhibited different slopes is not particularly important given that the greatest difference is only 6 percent.

Antecedent moisture content would also be similar for all sub-watershed pairs under ideal field conditions. However, due to the effect of surface residue on soil moisture, similar moisture contents were not anticipated. Moisture content of the soils ranged from a low of 8.8 % in the Kettle Creek **control** site prior to the post harvest simulation of 1991 (PH91) to a high of 37.3 % at the Pittock **test** site in the fall of 1990 (PT90).

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TABLE 3.13: CHARACTERISTICS OF RAINFALL SIMULATION SITES

Season	Site	Crop	Management Practice	Avg. Residue Cover (%)		Avg. Slope (%)		Avg. Antecedent Moisture (%)	
PT90	essex test	winter wheat	2x discing	64	a*	2.4	a	18.6	a
	essex control	winter wheat	fall moldboard	5	b	5.3	b	18.6	a
	kettle creek test	corn	notill	80	a	6.5	a	34.1	a
	kettle creek control	corn	fall moldboard	3	b	11.4	b	31	a
	pittock test	corn	fall modified moldboard	10	a	13.2	a	37.3	a
	pittock control	corn	fall moldboard	3	a	7.2	b	32.6	b
PP91	essex test	winter wheat	2x disc	90	a	1.3	a	27.6	a
	essex control	winter wheat	fall moldboard	10	b	4.2	b	15.5	b
	kettle creek test	corn	notill	83	a	6.4	a	28.6	a
	kettle creek control	corn	fall moldboard	10	b	6.8	a	28	a
	pittock test	alfalfa	2x chisel plow	38	a	4.2	a	28.6	a
	pittock control	alfalfa	fall moldboard	12	b	3	a	16	b
PH91	essex test	soybeans	2x discing	54	a	2	a	16.5	a
	essex control	soybeans	fall moldboard	67	b	3.7	a	15.5	a
	kettle creek test	corn	notill	91	a	3.3	a	16	a
	kettle creek control	corn	fall moldboard	83	a	5.5	a	8.8	b
	pittock test	corn	notill	90	a	2.6	a	35	a
	pittock control	corn	fall moldboard	85	a	1.2	a	19.3	b
PT91	essex test	soybeans	2x discing	39	a	1.3	a	15.6	a
	essex control	soybeans	fall moldboard	36	a	2.1	a	14.9	b
	kettle creek test	corn	notill	91	a	3.3	a	16	a
	kettle creek control	corn	fall moldboard	8	b	6.3	b	23.9	b
	pittock test	corn	notill	90	a	2.6	a	35	a
	pittock control	corn	fall moldboard	3	b	8.9	b	34.1	a
PP92	essex test	soybeans	2x discing	50	a	1.6	a	21.8	a
	essex control	soybeans	fall moldboard	5	b	5.1	b	24.5	a
	kettle creek test	corn	notill	93	a	2.7	a	23	a
	kettle creek control	corn	fall moldboard	30	b	3	a	25.5	a
	pittock test	corn	notill	80	a	1.8	a	29.8	a
	pittock control	corn	fall moldboard	16	b	3.2	a	22.7	b

* Test and control pairs with the same letter are not significantly different at alpha = 0.05

In general, statistical analysis showed a significantly greater mean antecedent moisture content in the **test** soils (25.6%) compared to the **control** sites (22.1%). In terms of watersheds, Pittock had the highest mean moisture content (**test** and **control** sites grouped together) (29.1%) followed by Kettle Creek (23.5%) and Essex (18.9%). In terms of seasonal differences in moisture content, PT90 was significantly wetter than all the other seasons and pre-plant 1992 (PP92) was significantly drier than the others. No significant differences were noted between PP91, PH91 and PT91.

Hydrological Parameters

Hydrological parameters measured during the rainfall simulations included time to ponding (TTP), time to runoff (TTR) and total runoff volume. The following sections discuss the findings for each parameter on a general basis and for each watershed. Mean values are presented here and individual data are listed in Appendix C.

Time to Ponding

An important hydrological factor measured during rainfall simulation was the time required from the beginning of the test for puddles to appear on the soil surface. This is known as the time to ponding. The appearance of ponding on the soil surface indicates that the surface of the soil has become saturated and that the rate of rainfall has exceeded the infiltration rate of that soil. Factors which affect the infiltration rate include soil porosity, antecedent moisture conditions and surface residue cover.

When grouped together into one data set of **test** and **control** values, the mean time to ponding was not found to be significantly different between **test** and **control** watersheds. On a watershed basis, however, mean TTP values were significantly longer (86 seconds) on the Essex sites with generally lower soil moisture compared to Kettle Creek and Pittock sites (50 and 47 seconds respectively). This may be a result of more cracks in the clay soils or a larger

number of earthworm burrows in the Essex area. This suggests that macroporosity is a primary factor here in determining infiltration rather than the infiltration rate of smooth surfaces. Significant differences were also noted when the data was examined on a seasonal basis. Results show that PP92 runs had the highest mean TTP value (153 seconds) and were significantly different from all other seasons. PP91, however, showed the lowest mean TTP value of 26 seconds but was only significantly lower than the PT91 and PP92 runs which had similar soil moisture levels. No differences were noted between the PT90, PH91 and PT91 runs.

The following sections discuss the time to ponding values obtained for each of the three watersheds.

Essex

Figure 3.13 illustrates the mean time to ponding (in seconds) for all Essex watershed rainfall simulations by season. No real trend was noted in term of whether the **test** plots took longer to pond than the **control** plots. It is interesting to note that the time to ponding seemed much longer in the PP92 runs compared to all others despite the fact that average soil moisture levels were the highest at that time. Statistical results showed significant differences did exist between **test** and **control** sites during the PT90 runs and the PP92 runs. In the PT90 runs, the control site shows a longer mean TTP but the situation is reversed in the PP92 runs.

Kettle Creek

Figure 3.14 illustrates the mean TTP values measured at the Kettle Creek sites. As with the Essex tests, the means vary greatly. In some seasons, the **test** sites took longer to pond while the control sites take longer to pond at other times. Significant differences between sub-watershed pairs only exist for the PP92 runs where the control sites took longer to pond. As in Essex and Kettle Creek the highest TTP measurements occurred in PP92; however, soil moisture was less at that time than during most of the previous periods.

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Figure 3.13: Rainfall Simulation-Essex
Average Time to Ponding by Season

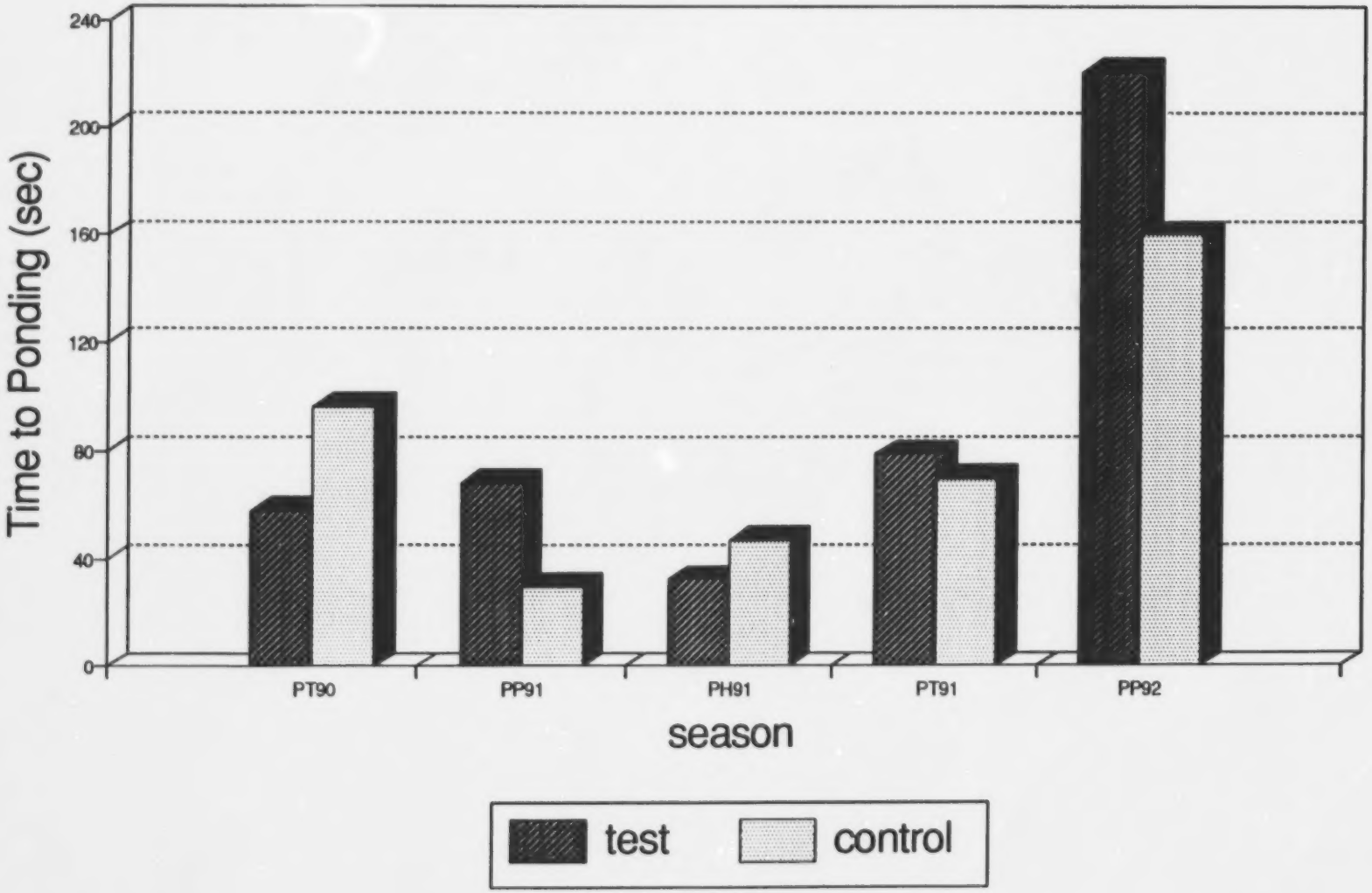


Figure 3.14: Rainfall Simulation-Kettle Creek
Average Time to Ponding by Season

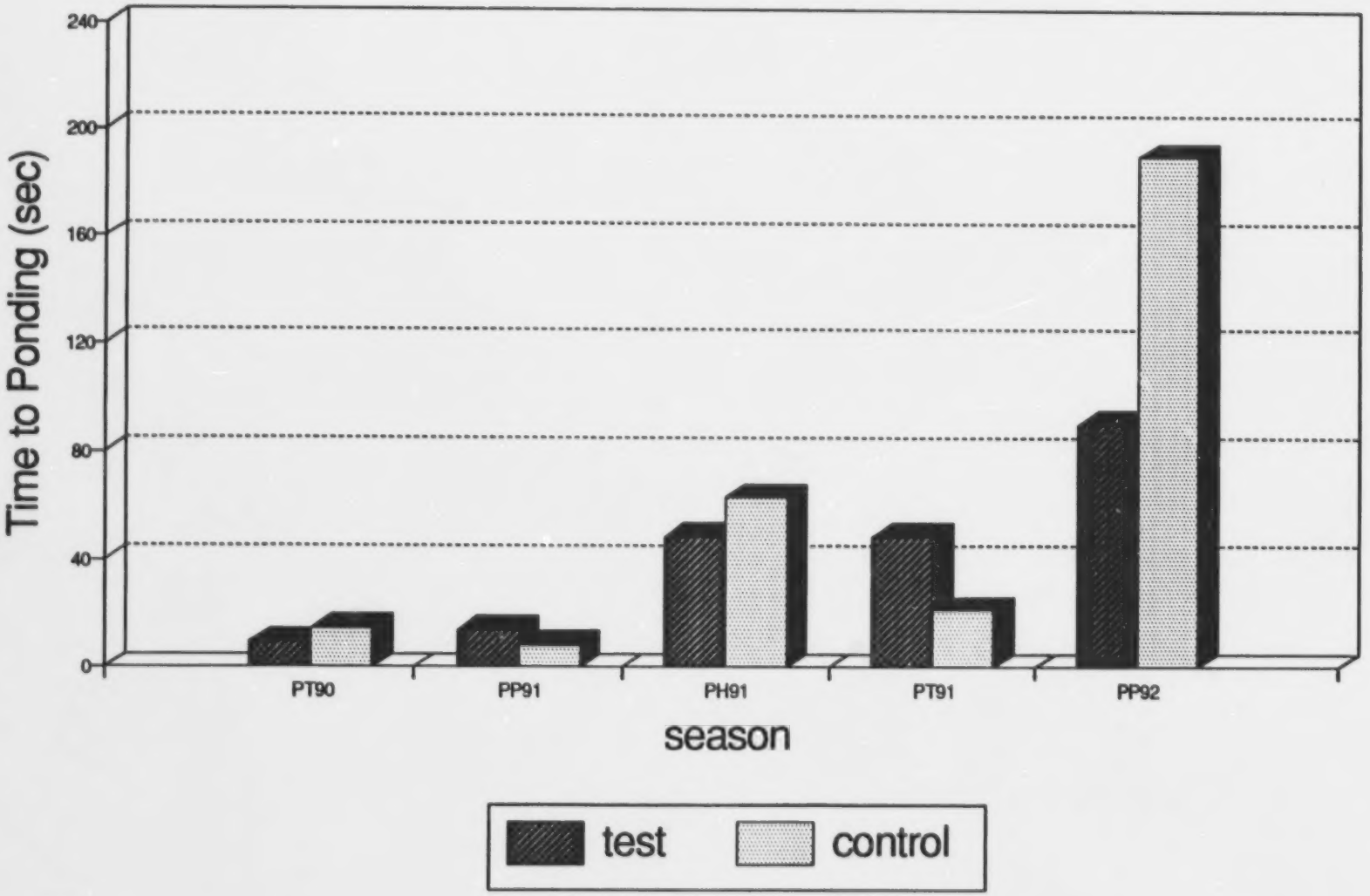
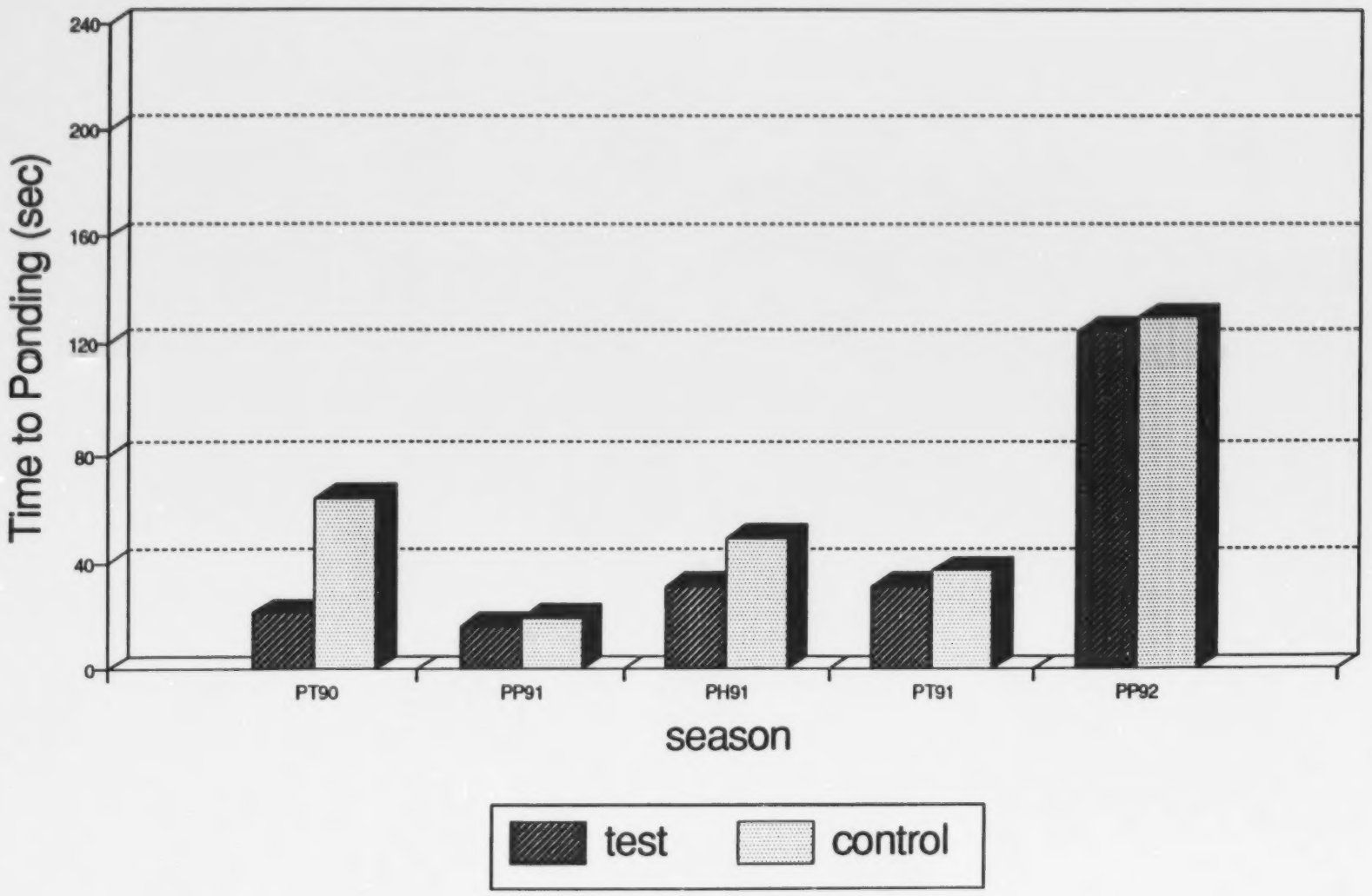


Figure 3.15: Rainfall Simulation-Pittock Average Time to Ponding by Season



Pittock

Mean times to ponding for the Pittock watershed are presented in Figure 3.22. This graph shows a general trend for ponding to take longer in the **test** sites as compared to the control sites. However, these differences were not significant at the 95% level of confidence.

In summary, TTP values varied significantly and no real trend was observed between sub-watershed pairs or seasons. However, the results did show a significant increase in TTP values for the Essex area compared to Kettle Creek and Pittock. The literature has discussed the high spatial variability of infiltration rates in soils. Since only 3 replicates were sampled in each sub-watershed pair, spatial variability may be the cause of the lack of significant differences. It is expected that further testing would improve upon the identification of trends.

TIME TO RUNOFF

Another important measurement taken during rainfall simulation was the time required for runoff to occur. Also linked to surface infiltration rates, time to runoff (TTR) can provide some insight into the surface storage capacity of the soil. The rougher the soil surface, the greater its ability to hold water in the depressions. Thus, freshly plowed soils would be expected to take longer to generate runoff than smooth, flat soil surfaces.

When examined all together, mean TTR values were very similar for both the **test** and **control** sites taking on average, 204 and 210 seconds for runoff to occur respectively. From a watershed standpoint, the Pittock sites took significantly less time to generate runoff (140 sec) than Kettle Creek or Essex sites (217 and 263 sec respectively). On a seasonal basis, TTR values for the PT90 runs were significantly lower (145 sec) than the PH91 and PT91 runs (264 and 252 sec respectively). No significant differences were noted between the PT90, PP91 and PP92 runs. Also, no significant differences were noted between the PP91, PH91, PT91 and PP92 runs.

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Comparisons of time to runoff values between **test** and **control** sites for each of the 3 watersheds are provided in the following sections.

Essex

Figure 3.16 shows the mean TTR values measured in the Essex **test** and **control** sites for all 5 measurement periods. No specific trend is apparent in terms of the **test** sites being faster or slower to generate runoff in comparison to the control sites. None of the differences between the test and **control** values were found to be significant.

Kettle Creek

Mean TTR values measured in the Kettle Creek watershed are presented in Figure 3.17. In all but the PH91 and PT91 runs, TTR values seemed higher in the control sites. The situation was reversed for the PH91 and PT91 runs. As with the Essex data, however, none of the differences proved to be statistically significant and no trends are apparent.

Pittock

Figure 3.18 shows mean TTR values for the Pittock watershed. Again, no trend is observed in these data nor were any of the differences found to be statistically significant.

Like the TTP values, TTR values showed no relationship to conservation and conventional management practices. Again, the lack of differences may be a result of the high spatial variability of the soils' hydrological properties.

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Figure 3.16: Rainfall Simulation-Essex
Average Time to Runoff by Season

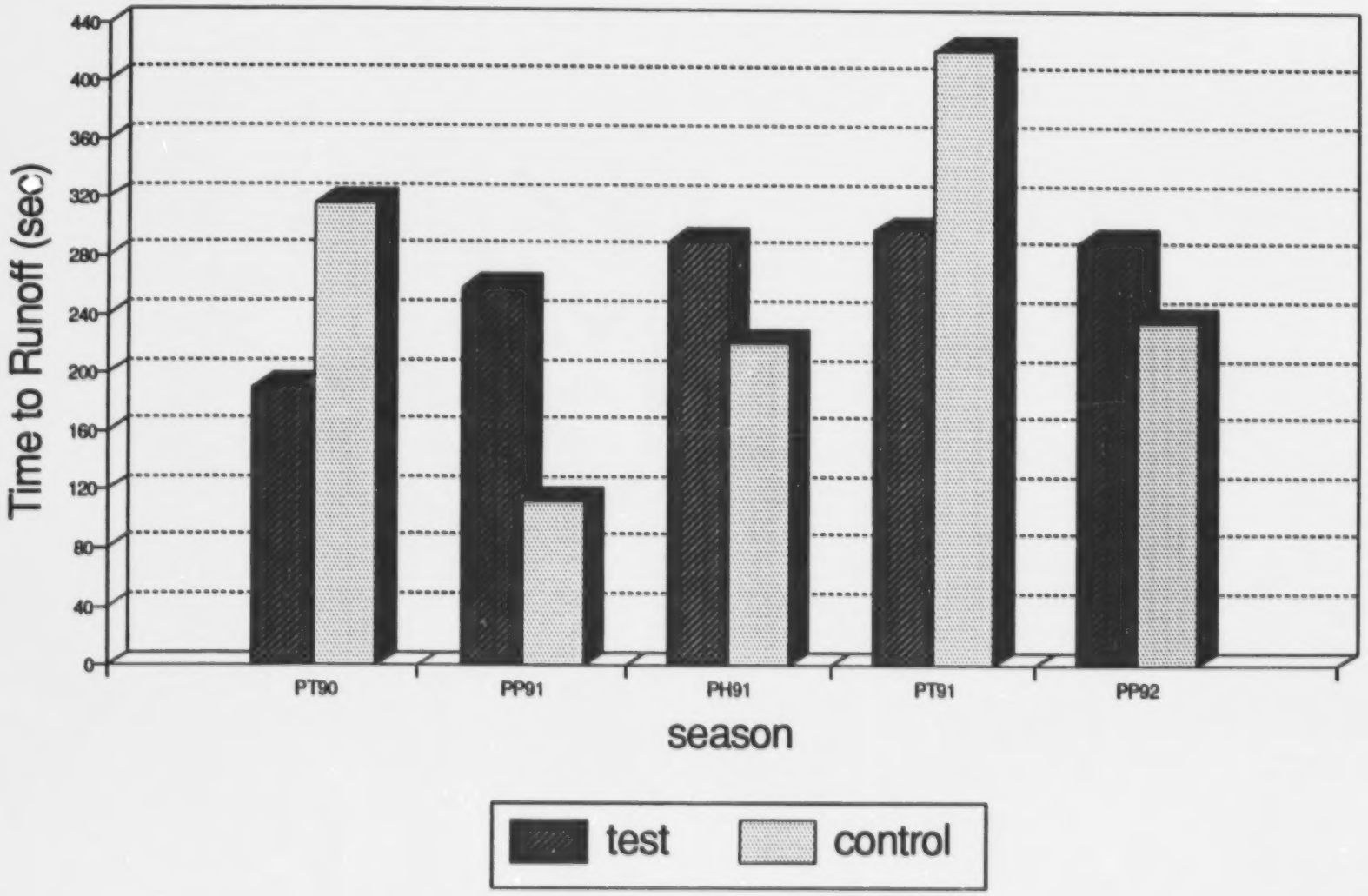


Figure 3.17: Rainfall Simulation-Kettle Creek Average Time to Runoff by Season

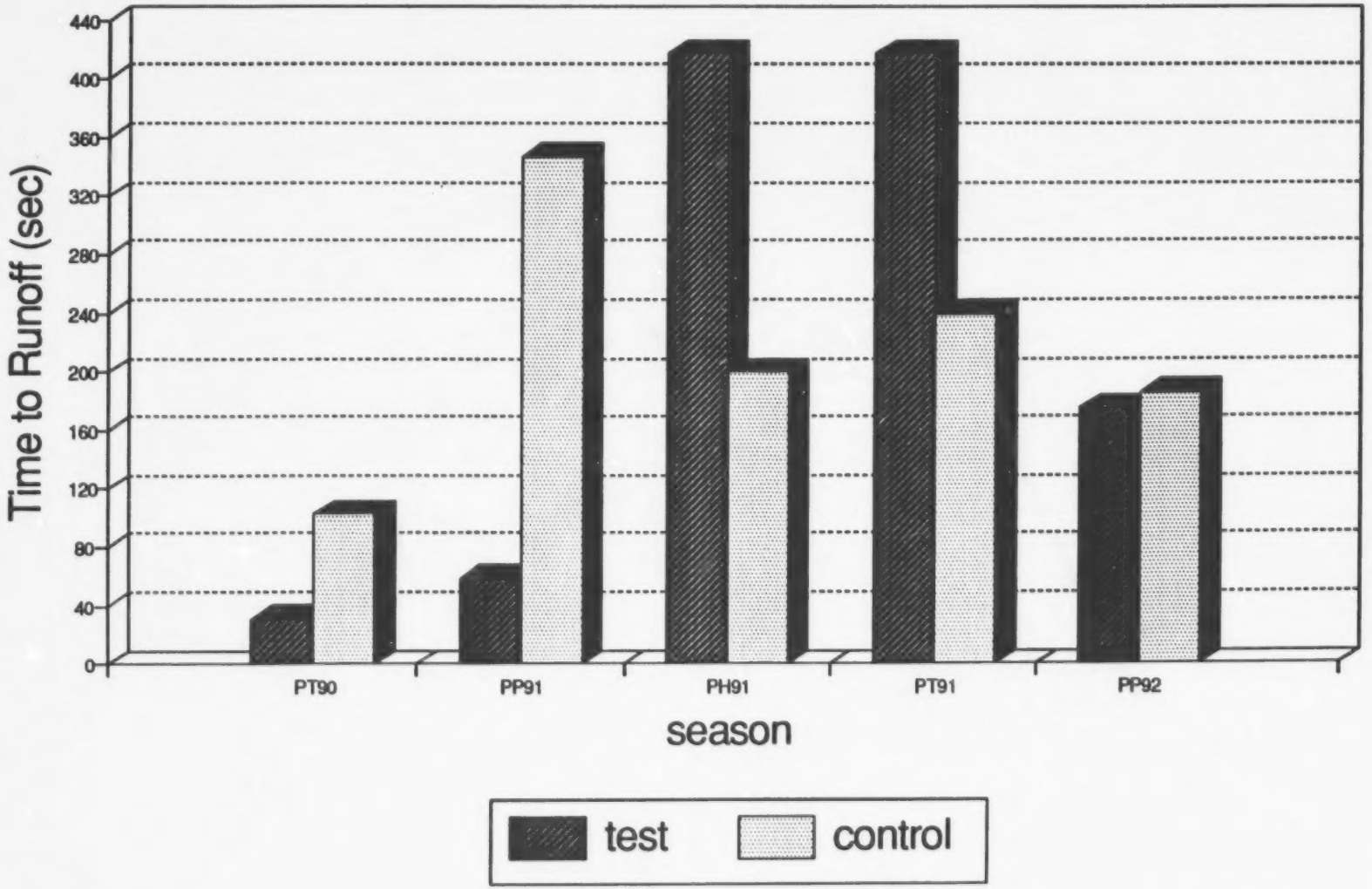
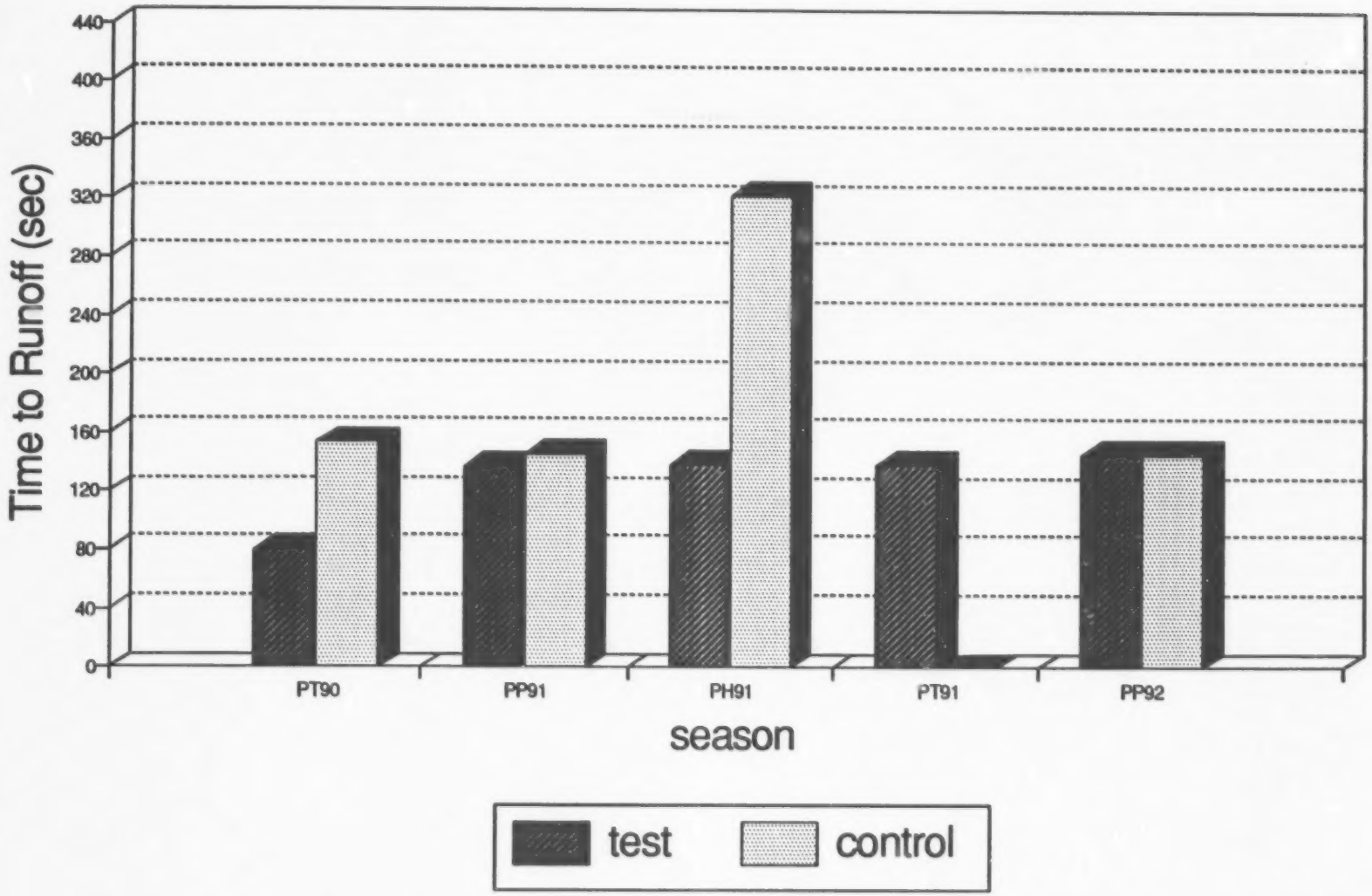


Figure 3.18: Rainfall Simulation-Pittock Average Time to Runoff by Season



TOTAL RUNOFF

The most important hydrological property examined in the rainfall simulation studies was total runoff. Whether or not conservation management practices result in less or more runoff than conventional systems continues to be argued in the literature. Some papers indicate that the increased level of surface residue will lead to greater runoff because more of the soil is protected by the crop residue. Other studies showing increased infiltration in soils under conservation systems attribute this to increased macroporosity which can increase infiltration. Increased infiltration leads to a reduction in surface runoff.

Initially, the runoff data were analyzed as one large data set with **test** and **control** values lumping watersheds and seasons together. Results of the statistical analyses on these data showed a significant increase in total runoff from the **test** sites (7227 mL) as compared to the control sites (3879 mL). These results indicate that increased residue cover does lead to an increase in surface runoff. Mean runoff volumes proved to be significantly larger on the Kettle Creek watershed (7702 mL) when compared to the Essex (4887 mL) and Pittock (4070 mL) sites. Fall of 1991 (PH91 and PT91) runs generated significantly lower runoff than the 1990 fall values and the spring values. The highest runoff was generated in the PP91 season but was not significantly greater than the PT90 or PP92 runs. No differences were found between the PT90 and PT91 values.

Details of runoff volumes are discussed on an individual watershed basis in the following sections.

Essex

Figure 3.19 displays the mean total runoff volumes for the **test** and **control** sites in the Essex Watershed. The only obvious generality that can be noted here is that during the PP91 and PP92 periods the **control** flow exceeded the **test** flow and these periods generated the highest total outflow.

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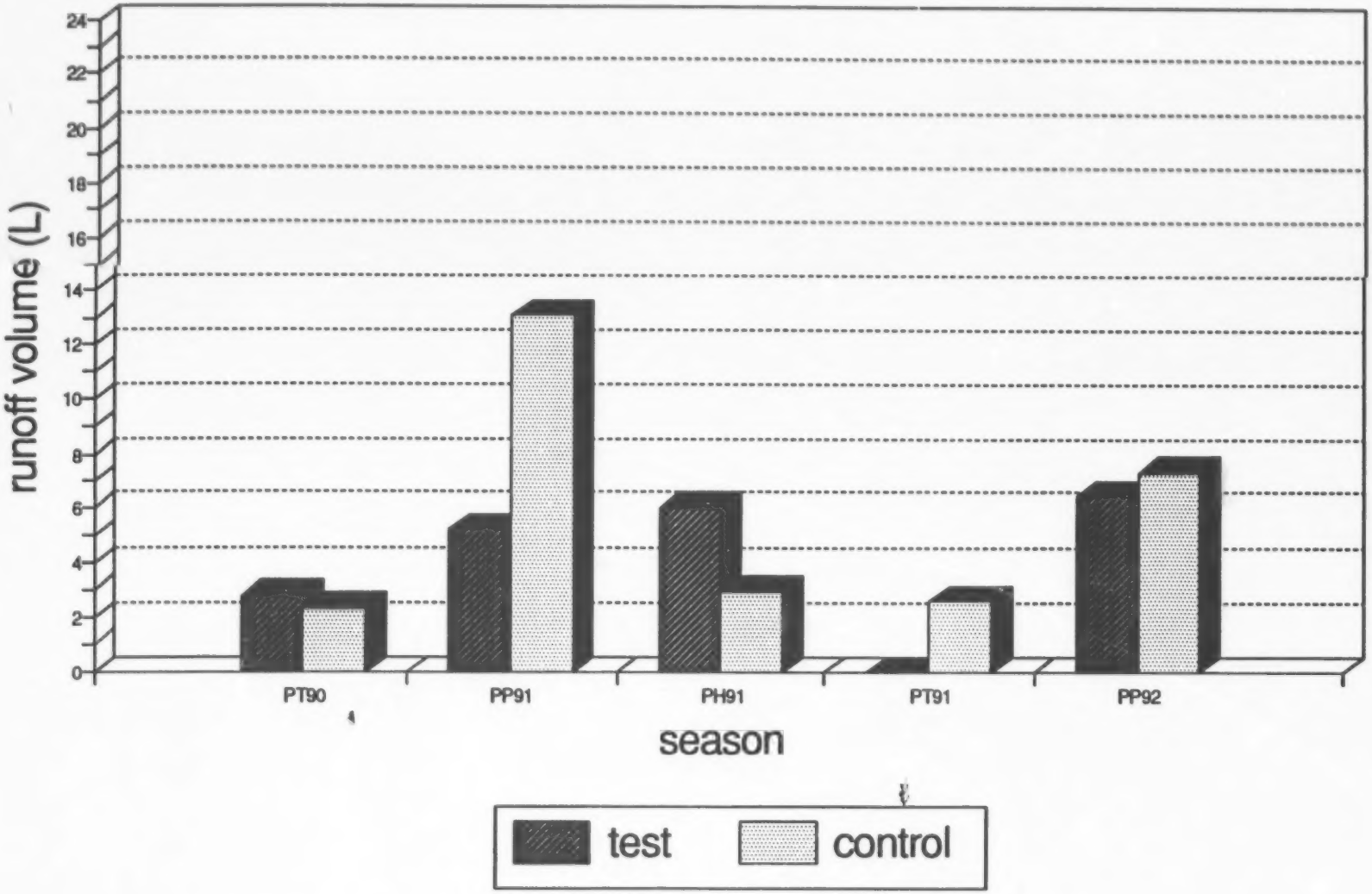
Figure 3.19: Rainfall Simulation-Essex Average Runoff by Season



Kettle Creek

Figure 3.20 displays Kettle Creek plot runoff volumes. This watershed generated the highest volumes especially during the PT90 and PP91 tests. **Test** runoff was higher than **control** in all but one season (PH91) when runoff volumes were low on both **test** and **control** plots.

Pittock

Figure 3.21 displays Pittock plot runoff. While runoff is low overall, **test** plot runoff exceeds **control** plot runoff in all seasons on average. The most pronounced differences are in 1991.

Figure 3.22 summarizes the total runoff results for all watersheds by season along with some accompanying relevant data. The average % cover is indicated below each histogram bar and the significance level is indicated atop each pair of bars. In this, a value of 79 indicates that the bars are significantly different at a confidence level of 79%. Because of the relatively small number of replicates and the heterogeneous nature of the landscape tested, it is anticipated that sets of runoff data could be significantly different but may not pass the test at a rigorous level such as 95%.

Various observations are presented here from this summary figure:

- **Test** and **control** runoff are significantly different at levels of 56 to 99% in all cases except for pre-plant in Kettle Creek. Several comparisons are significant at levels of 79% or greater.

- There is no season in which all watersheds display the same trend in terms of which sites generated the most runoff.

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Figure 3.20: Rainfall Simulation-Kettle Creek Average Runoff by Season

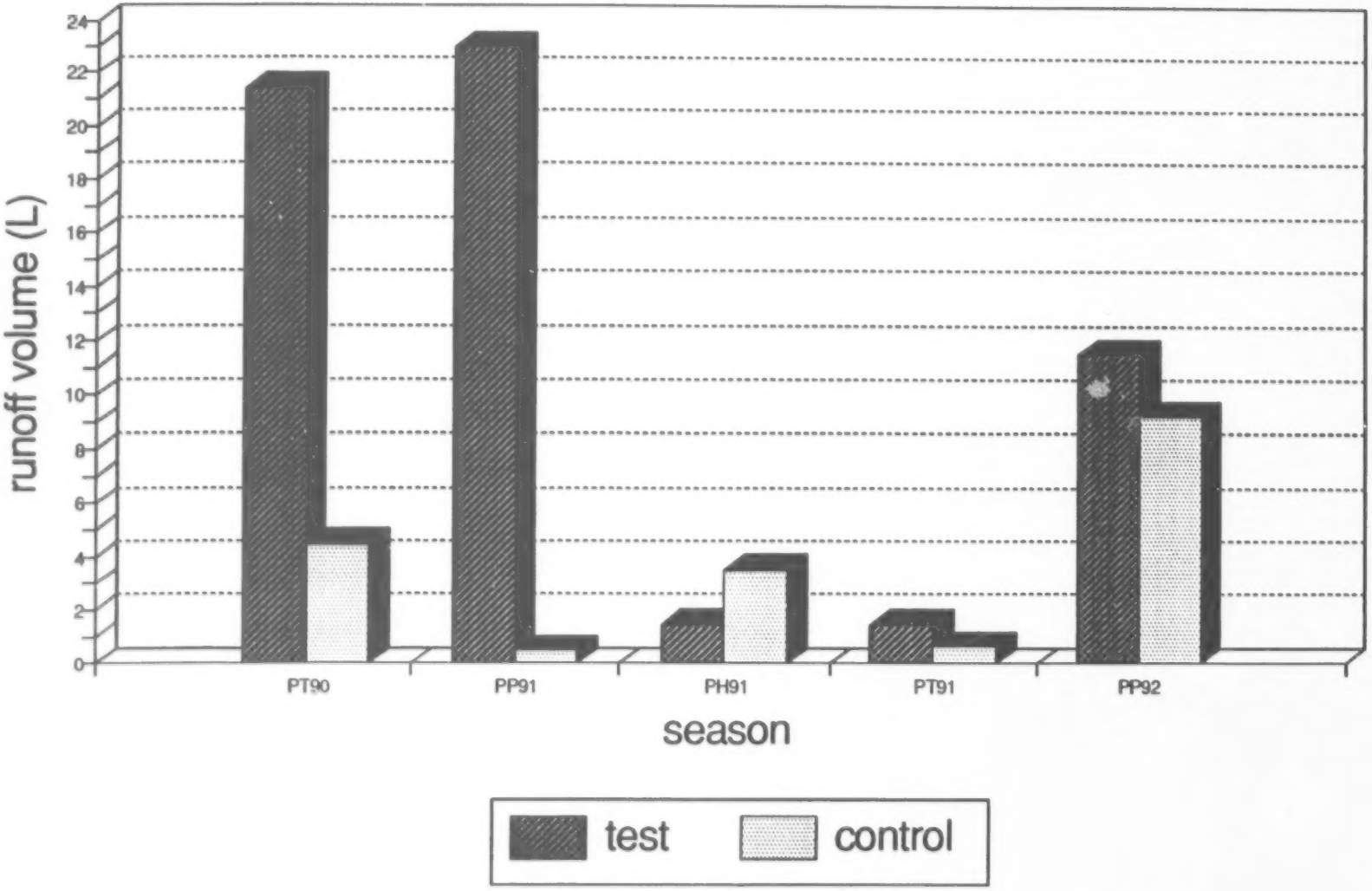


Figure 3.21: Rainfall Simulation-Pittock Average Runoff by Season

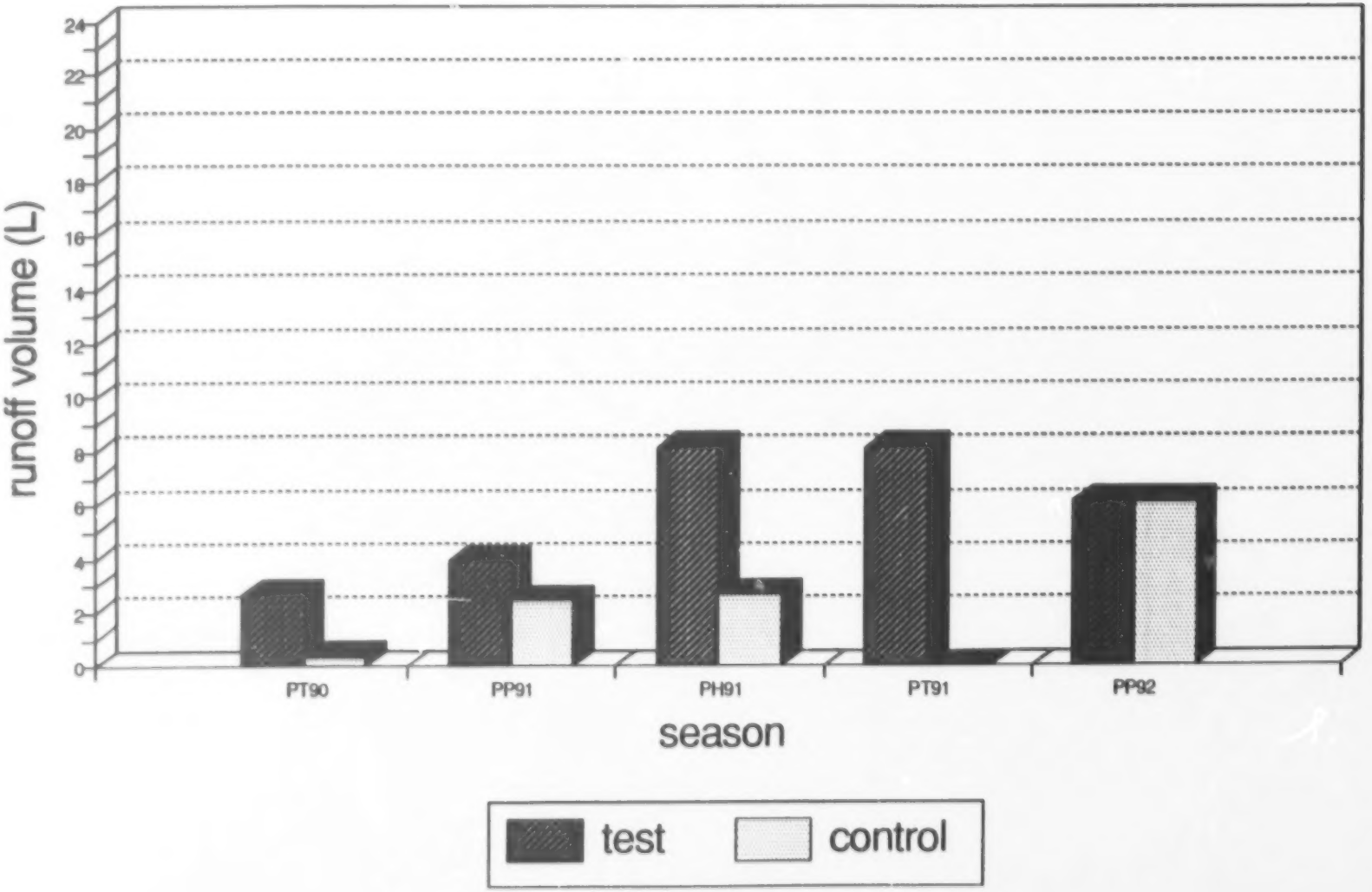
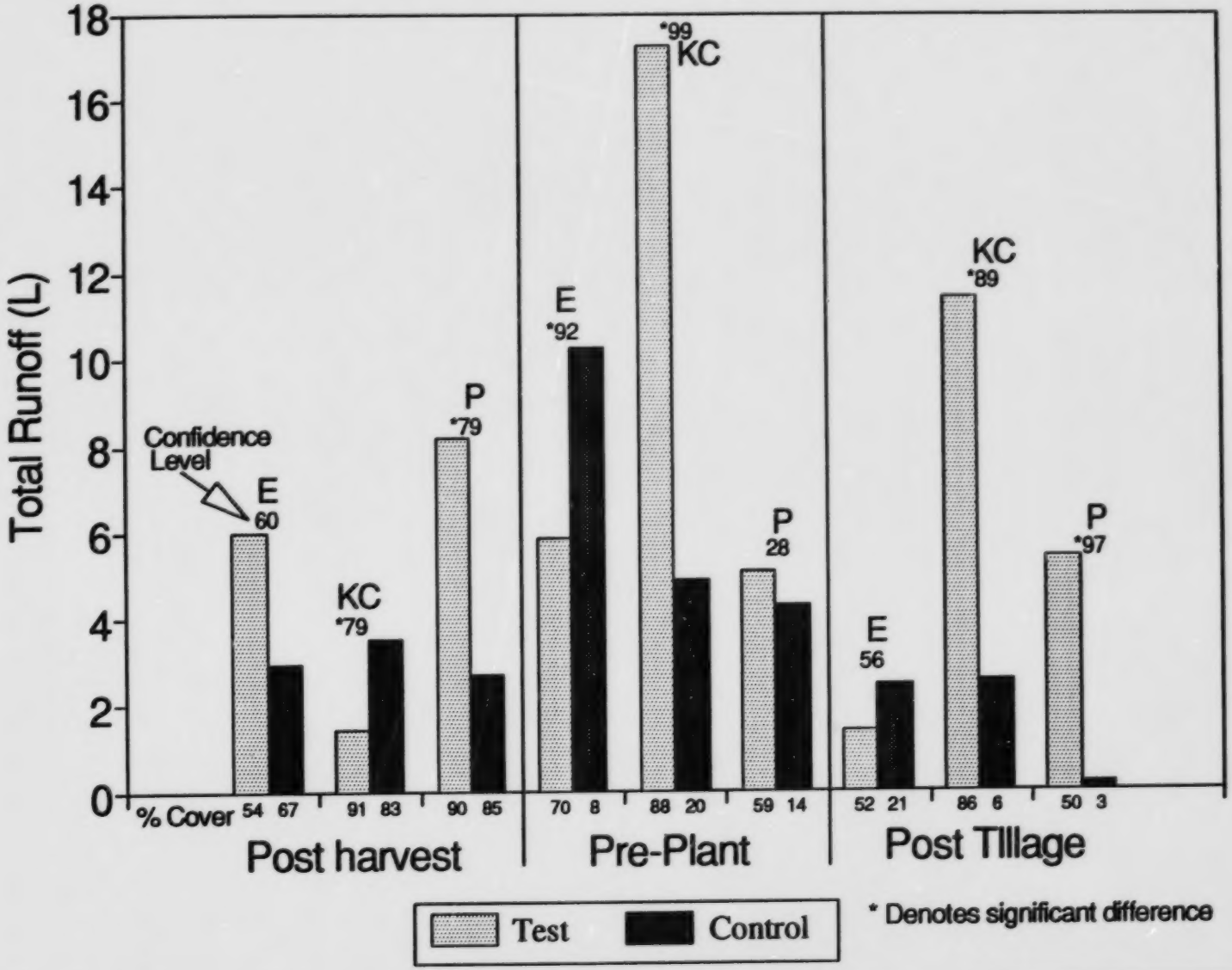


Figure 3.22: RAINFALL SIMULATION SUMMARY

TOTAL RUNOFF



- **Test** plots generated more runoff in six of nine comparisons although one case was not significant (Pittock in pre-plant periods).

- Post-tillage runoff was generally the lowest for all **control** sites. This is likely due to high surface roughness and surface storage on **control** sites.

- Pre-plant periods generated the most runoff from **control** sites in all cases. This period represents low cover and relatively undisturbed conditions.

- Runoff from all **test** plots do not follow seasonal patterns and very widely between watersheds in each season.

- In most cases where the difference in cover is the most pronounced, pre-plant and post tillage, the runoff comparison between **test** and **control** is highly significant. The exceptions are pre-plant in Pittock and post tillage in Essex.

- When **test** plot cover greatly exceeds that on the **control** plots the **test** outflow is the greatest except pre-plant in Essex and post tillage in Essex.

- Essex **control** plots generally have higher runoff and much lower cover than **test** plots except after harvest when both plots behave similarly and have similar cover.

- Kettle Creek **test** plots have generated much more runoff than **control** plots when cover is much higher on the **test** plots.

- Pittock **test** plots always generated more runoff on average and contained more cover than **control** plots.

- The post harvest period is one in which **test** and **control** plots do not follow clear trends. Cover levels are high in both cases and therefore plots do not differ in this respect. Levels of significance in simple comparisons were low and inconclusive. This period had the lowest average soil moisture at 18.5% compared to 26.0% and 24.3% for post tillage and pre-plant respectively. Accordingly, total runoff levels were also low especially in the **control** plots.

- The pre-plant period displayed conflicting trends between Essex and Kettle Creek in terms of **test** versus **control** runoff. Pittock **test** and **control** plots were not significantly different. Total runoff was generally highest in this period.

- The post tillage period displayed significantly higher runoff from **test** plots with much higher cover in Kettle Creek and Pittock while Essex plots were not significantly different.

CORRELATIONS AMONG PARAMETERS

Correlations and regression analyses were employed on the water quantity data set to determine if any significant relationships existed among the parameters when all tests were compared. No significant relationships were noted between the parameters.

Multiple regression analysis was run to establish the equation to determine runoff using residue, time to ponding, time to runoff soil moisture and slope. The resulting equation and the r^2 value is reported below.

Runoff = 70.3 x residue + 11.8 x TTP - 12 x TTR + 129.9 x soil moisture + 181.5 x slope

$r^2 = 0.5843$

where: TTP_2 = time to ponding, and

TTR = time to runoff

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Obviously, the residue, TTP, TTR, soil moisture and slope factors are accounting for only 58 % of the factors affecting runoff. Thus, this equation will not be particularly reliable for predicting runoff. Interestingly, residue is positively correlated to runoff meaning that higher surface residue equals higher runoff. As expected, soil moisture and slope are positively correlated to runoff. Time to runoff is negatively correlated to runoff meaning that the faster runoff occurs, the more runoff that will be generated which makes sense. Time to ponding is positively correlated to runoff which was not anticipated.

3.4 Groundwater

Groundwater seepage to agricultural drains constitutes the sole significant source of sub-watershed outflow during interevent periods. In the spring and fall, when evapotranspiration rates are low, groundwater seepage rates are high. These seepage rates may be assisted by subsurface drainage, especially in Essex, when groundwater levels are near the surface. During the growing season, groundwater levels often drop to below the datum of the drains and sub-watershed outflow ceases. Groundwater can be a significant source of phosphorus and other agricultural chemicals to the sub-watershed loads.

Tables 3.14 to 3.17 summarize the groundwater data by site for the years 1989 to 1992. In this table the depth from the surface is indicated. Monthly average depths of less than 25 cm occur in the spring and fall while summer values extend beyond 2 metres in some cases. In fact, several piezometers were observed to be dry for extended periods of time in the summer months. Groundwater levels correlate closely to baseflow levels at the sub-watershed outlets. In Essex, the sub-watershed outlet flow drops to zero in August and October of 1989 and from July to October in 1991. Average depth to groundwater at these times for all four piezometers is greater than 1.3 metres. Similarly in Kettle Creek, sub-watershed outflow decreases to zero when depth to groundwater exceeds 1.5 metres.

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TABLE 3.14: MONTHLY AVERAGE DEPTH TO GROUNDWATER: 1989

	DEPTH TO GROUNDWATER (cm)											
	Essex				Kettle Creek				Pittock			
Location	Control 1	Control 2	Test 1	Test 2	Control 1	Control 2	Test 1	Test 2	Control 1	Control 2	Test 1	Test 2
January	na	na	na	na	na	na	na	na	na	na	na	na
February	na	na	na	na	na	na	na	na	na	na	na	na
March	na	na	na	na	na	na	na	na	na	na	na	na
April	na	na	na	na	na	na	na	na	na	na	na	na
May	139	107	73	105	64	45	87	86	95	90	na	60
June	98	101	54	95	30	25	119	32	101	97	na	50
July	128	121	89	114	94	77	158	114	149	125	na	70
August	151	140	108	130	129	117	176	148	178	169	na	88
September	146	152	76	176	149	73	215	174	na	na	na	122
October	127	160	89	195	137	50	241	140	na	na	na	135
November	103	200	65	152	36	17	164	46	105	83	59	152
December	118	210	87	110	na	na	na	na	104	116	70	48

TABLE 3.15: MONTHLY AVERAGE DEPTH TO GROUNDWATER: 1990

	DEPTH TO GROUNDWATER (cm)											
	Essex				Kettle Creek				Pittock			
Location	Control 1	Control 2	Test 1	Test 2	Control 1	Control 2	Test 1	Test 2	Control 1	Control 2	Test 1	Test 2
January	97	131	54	93	na	na	na	na	25	54	48	64
February	84	62	46	96	na	na	na	na	43	35	0	18
March	56	98	96	78	195	240	44	31	33	32	16	24
April	51	94	91	74	193	25	49	20	58	78	33	80
May	67	103	104	97	56	49	88	63	87	95	63	80
June	89	126	117	117	68	58	98	51	133	118	94	105
July	100	174	127	129	51	45	107	53	134	91	48	65
August	76	175	106	151	61	48	131	84	125	112	62	86
September	64	91	94	82	21	27	64	31	119	112	54	90
October	73	99	104	97	21	37	48	25	93	86	32	65
November	66	94	96	83	15	38	42	16	65	70	11	63
December	46	83	80	62	6	30	33	6	na	na	na	na

TABLE 3.16: MONTHLY AVERAGE DEPTH TO GROUNDWATER: 1991

	DEPTH TO GROUNDWATER (cm)											
	Essex				Kettle Creek				Pittock			
Location	Control 1	Control 2	Test 1	Test 2	Control 1	Control 2	Test 1	Test 2	Control 1	Control 2	Test 1	Test 2
January	109	97	84	81	58	62	98	52	107	86	0	84
February	na	na	na	na	na	38	92	na	78	68	11	60
March	101	88	48	98	6	33	27	na	51	45	8	56
April	108	111	73	99	32	58	73	47	48	49	33	74
May	110	110	93	102	88	85	148	90	126	113	81	90
June	118	144	109	114	123	116	189	120	164	125	101	101
July	178	196	203	206	175	141	216	155	201	166	147	120
August	235	245	235	255	180	173	249	206	204	166	147	120
September	263	258	262	174	195	192	249	210	204	171	147	180
October	199	259	183	159	178	161	249	210	204	171	147	191
November	95	259	425	101	109	103	249	154	204	171	147	165
December	na	na	na	na	45	35	249	36	131	118	63	138

TABLE 3.17: MONTHLY AVERAGE DEPTH TO GROUNDWATER: 1992

	DEPTH TO GROUNDWATER (cm)											
	Essex				Kettle Creek				Pittock			
Location	Control 1	Control 2	Test 1	Test 2	Control 1	Control 2	Test 1	Test 2	Control 1	Control 2	Test 1	Test 2
January	106	75	42	100	20	37	72	24	90	75	31	57
February	97	79	39	103	5	30	50	12	64	60	20	31
March	101	84	42	104	15	29	45	10	38	25	0	6
April	100	83	44	96	18	40	102	24	54	60	24	71
May	na	na	na	na	80	82	126	100	61	100	26	104
June	117	191	95	108	133	105	168	140	na	na	na	na

In Pittock, the **test** sub-watershed runs dry when depth to groundwater exceeds 1.3 metres while in the **control** sub-watershed baseflow rarely ceases even as depth to groundwater drops below 2.0 metres.

Figures of depth to groundwater are provided in Appendix D. These figures display the time varying nature of groundwater levels, especially during the growing season.

3.5 Soil Moisture

Figures are provided in Appendix D of soil moisture at each installation throughout the study period. These figures indicate soil moisture in terms of negative pressure in kPa. A fully saturated soil has a negative pressure of zero while a very dry soil will have a negative pressure which approaches 3000 kPa.

Soil moisture is a useful indicator to farmers of the available moisture to plants and is a primary management parameter for demand-based irrigation systems. Soil moisture is also a useful measure of antecedent moisture conditions. That is, when soil moisture is high, surface runoff is more likely to accompany a storm event. Soil moisture is also affected by residue and tillage practices and is therefore dependent upon these land management systems. Soil moisture has been used in this study as an independent variable in plot and field scale evaluations of runoff loadings.

The figures in Appendix D reflect the general moisture conditions and streamflow conditions observed throughout the study. In the summers of 1989 and 1991 soil moisture values indicated very dry conditions at both measurement depths for extended periods. Soil moisture responded quickly to reflect replenishment following significant storms such as the late July storm of 1991 in Pittock.

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4.0 DISCUSSION AND CONCLUSIONS

4.1 Discussion

4.1.1 Watershed Scale

The analysis of seasonal watershed scale runoff has indicated that residue positively affects runoff in Essex, negatively affects runoff in Kettle Creek, and in Pittock a trend is not conclusive. The Essex observation is reinforced by the observation that as cover levels generally increased in Essex **test** in the latter part of the study, the **test** outflow grew relative to **control** outflows. However, the relationship between seasonal outflow and cover in Essex was not highly significant ($r^2 = 0.64$).

The reverse trend in Kettle Creek was highly significant ($r^2 = 0.90$) although the effect is not apparent in the latter period of the study. During 1991 and 1992 when **test** sub-watershed residue levels are the highest, the ratio of **test** outflow to **control** outflow is inconsistent, varying from less than 1.0 to greater than 1.0.

Due to long extended dry periods in the Pittock **test** sub-watershed a rigorous seasonal analysis was impossible. Therefore no trend can be identified at the watershed scale in Pittock. During 1990 when **test** cover exceeded **control** cover by the greatest amount the **test** outflow exceeded **control** outflow by the greatest amount. It is therefore speculated that a positive correlation between cover and watershed scale outflow may exist in Pittock.

4.1.2 Microbasins

Three of the four Essex microbasins displayed a positive relationship between cover and runoff at high levels of significance. This result confirms the watershed scale observation for Essex.

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In Kettle Creek, only one microbasin displayed a positive relationship between outflow and cover with a modest correlation coefficient. This result does not support the watershed level analysis which indicated a negative relationship between cover and outflow. Non-existant relationships between cover and outflow in the remaining three microbasins suggest that other factors may be confounding the analysis at this scale.

Only one microbasin in Pittock displayed a trend (negative) between cover and outflow with a poor correlation coefficient. As in Kettle Creek other factors are likely confounding the simple comparisons employed here.

Other factors such as soil moisture, precipitation volume and antecedent precipitation could not be identified as consistently significant factors in determining runoff from the microbasins.

4.1.3 Rainfall Simulation Scale

Rainfall simulation results have produced some expected results and some contradictions to the watershed and microbasin scales.

The time to ponding parameter is shown to be related to soil moisture when all areas are lumped although no trend was apparent between **test** and **control** sites.

The time to runoff data was not particularly useful as no trends could be identified except that, as expected, time to ponding was lowest in Pittock where soil moisture levels tended to be the highest.

The total runoff from **test** plots was generally higher than from **control** plots but this was largely due to much higher **test** plot runoff in Kettle Creek in PT90 and PP91 and in Pittock for all tests.

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Essex did not display clear trends between **test** and **control** in the post harvest or post tillage periods but did display higher **control** runoff during the pre-plant tests when **test** cover was much higher than **control**. This result is contrary to the whole watershed and microbasin scale results which displayed the reverse trend. One explanation for this is that macroporosity is a major factor determining surface runoff at the plot scale, leading to reduced surface runoff from minimum tillage plots while at the larger scales the macroporosity may be accelerating tile drainage and thereby increasing total runoff including tile drain flow. Also, at the larger scales, minimum tillage may result in the maintenance of surface sealing and accelerated surface runoff. This is particularly evident following tillage in most tests.

Kettle Creek displayed a strong relationship between cover and runoff during pre-plant and post tillage periods when cover was much higher on **test** plots. Like in Essex, the plot scale observations are contrary to the whole watershed observations. One possible explanation here is that at the plot scale the most important determining factor is surface roughness (lower in minimum tillage) or infiltration rates (may be reduced by surface sealing in minimum tillage system). At the larger scales total runoff may be reduced by higher surface detention storage.

While Pittock displayed no significant trends at the larger scales it was the only watershed in which **test** outflow volume consistently exceeded **control** outflow. This trend was also observed at the watershed scale in 1990 in Pittock when **test** cover values were the highest.

Microbasin scale results are confounded by spatial heterogeneity in factors such as soil moisture, slope, cover and crop type. More replicates may be required in future tests to explain trends and allow for multivariate analysis.

4.2 Conclusions

The following generalized conclusions have been drawn from the hydrological aspects of the study.

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- At the whole watershed scale, the effects of conservation tillage upon runoff volumes are site specific. In Essex, conservation tillage and higher resultant cover tends to cause increased runoff from the **test** sub-watershed in the last 2 years of monitoring (1991-1992). In Kettle Creek, conservation tillage and increased cover has resulted in reduced runoff from the **test** sub-watershed on a seasonal and annual basis. In Pittock, no clear trend was apparent other than that the **test** unit area flows significantly exceeded the **control** for the entire period except for winter and spring of 1991.

- At the microbasin or field scale there is no clear pattern of dependency between unit area runoff and conservation system implementation in Kettle Creek or Pittock. Essex microbasins generally indicate that a positive relationship exists between runoff and cover.

- At the plot scale there are generally positive relationships between cover and runoff in Pittock and Kettle Creek but the reverse is indicated in Essex.

- Larger scale trends are contrary to plot scale trends in Essex and Kettle Creek. Pittock trends at the larger scales are not statistically significant but observations are consistent with plot scale observations.

- In Essex only the pre-plant period displayed a highly significant difference between runoff from **test** versus **control**. In that period the **control** plots generated significantly more runoff with much less plant residue. **Control** plot runoff during that time was significantly higher than during other times. This trend is contrary to larger scale observations.

- In Kettle Creek the **test** plot runoff was significantly higher than the **control** plot runoff during the spring pre-plant and fall post tillage periods. Residues on the **test** plots were much higher during those times. During the post harvest period the residues were

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similar and runoff differences were not highly significant. This result is contrary to whole watershed observations.

- In Pittock the **test** plot runoff exceeded **control** at a highly significant degree only during the post tillage period. Residues were most dissimilar at that time.

- Pre-plant runoff volumes were significantly higher in all areas than during the other times.

- **Control** runoff was the lowest during the post tillage period, undoubtedly due to high surface storage.

- **Test** plot runoff exceeded **control** plot runoff when all data is lumped.

- More replication is recommended in plot scale studies to reduce the effects of spatial heterogeneity.

- A larger database is required at the whole watershed scale to clearly identify the effects of tillage and residue on runoff.

- More microbasin events are required in order to provide for time trend analysis on individual microbasins. Direct comparison between microbasins is confounded by physical and agronomic differences.

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5.0 REFERENCES

Beak Consultants Limited and Conservation Management Systems. 1990. Pilot Watershed Study - Soil and Water Environmental Enhancement Program - 1989-1990 Annual Report.

Beak Consultants Limited and Conservation Management Systems. 1990. Master Implementation Plan - Soils, Agronomic and Environmental Components.

Beak Consultants Limited. 1990. Environmental Monitoring of SWEEP Pilot Watersheds. An annual project report to the Ontario Ministry of the Environment.

Brown, D.M., G.A. McKay, and L.J. Chapman. 1968. The Climate of Southern Ontario: Climatological Studies Number 5, Atmospheric Environment Service, Environment Canada.

Conservation Management Systems. 1989. Soil and Water Environmental Enhancement Program - Selection of Pilot Sub-watersheds.

McKeague, J.A. (ed.). 1978. Manual on Soil Sampling and Methods of Analysis. Canadian Soil Science, Ottawa, ON. 212 p.

Tossell, R.W., Dickinson, W.T., Rudra, R.P., and Wall, G.J. 1987. A portable rainfall simulator. Can. Agr. Eng. 29:155-162.

Wall, G.J., I.J. Shelton, W.T. Dickinson and R.P. Rudra. 1989. Temporal Variation of Some Soil Physical and Hydrological Properties. Agriculture Canada, Land Resource Research Centre Contribution No. 89-30. Guelph.

PRINTED ON RECYCLED PAPER

Water Survey of Canada. 1990. Report on Water Quantity Monitoring for Pilot Demonstration Watersheds (1988-89). Argent by M. Shaw for SWEEP.

Wischmeier, W.H. and Smith, D.D. 1978. Predicting rainfall erosion losses. A guide to conservation planning. U.S. Dep. Agric., Agriculture Handbook No. 537.

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APPENDIX A

WATERSHED SCALE HYDROLOGIC DATA

SUB-WATERSHED DAILY DISCHARGE

ESSEX TEST

TOTAL DAILY DISCHARGE FOR 1989 Essex Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	5.50	0.0518	3.11	0.270	31.4	0.194	0	0.0540	0	0.0864	0.0864	1
2	---	1.93	0.0346	2.61	0.266	40.4	0.162	0	0.0864	0	0.0144	0.0900	2
3	---	0.810	0.0144	38.9	0.274	28.7	0.173	0	0.0036	0	0	0.0605	3
4	---	0.385	0.112	27.0	0.173	14.6	0.130	0.0324	0	0	0	0.0432	4
5	---	0.216	0.400	11.7	0.241	3.73	0.0864	0.101	0	0	0	0.0720	5
6	---	0.191	0.138	5.50	0.266	1.97	0.0432	0.0792	0	0.0108	0	0.0864	6
7	---	0.0864	0	3.84	0.133	1.13	0	0	0.0648	0	0.0972	0.0180	7
8	---	0.0778	0	2.94	0.0864	0.770	0	0	0.245	0	0.0900	0	8
9	---	0.0691	0.0612	1.97	0.0864	0.630	0	0	0.126	0	0.0864	0	9
10	1.62	0.0605	0.112	1.23	0.0864	0.410	0	0	0.490	0.0612	0.148	0	10
11	0.778	0.0518	0.371	1.12	0.0828	0.158	0	0	0.133	0.0864	0.0972	0	11
12	1.56	0.0432	0.407	1.26	0.0972	0.230	0	0	0.0864	0.0108	0.0864	0.0259	12
13	0.796	0.156	0.176	2.22	0.162	0.382	0	0	0.0828	0	0.0864	0	13
14	0.328	0.306	0.238	2.22	0.0864	0.191	0	0	0.115	0	0.0864	0	14
15	0.425	0.421	0.464	3.47	0.0864	0.436	0	0	0.130	0	3.04	0	15
16	0.292	0.294	0.133	2.86	0.0864	5.29	0	0	0.648	0	6.87	0	16
17	0.310	0.199	0.0900	12.1	0.0576	2.03	0	0	2.40	0	1.39	0	17
18	0.457	0.147	3.54	16.0	0.0108	3.60	0	0	0.432	0	0.407	0	18
19	0.641	0.112	2.39	5.75	0.0108	71.3	2.13	0	0.126	0.306	0.227	0	19
20	0.644	0.115	1.77	3.52	0.169	32.2	69.6	0	0.0864	0.677	0.220	0	20
21	0.190	0.346	1.73	2.87	0.133	4.33	7.11	0	0.0864	0.400	0.140	0	21
22	0.140	0.242	1.88	2.32	0.0864	2.06	2.07	0	0.0864	0.194	0.0864	0	22
23	0.194	0.156	1.77	1.65	0.0864	1.33	1.63	0	0.0864	0.104	0.0864	0	23
24	0.173	0.0864	1.72	1.26	0.0864	0.929	1.01	0	0.0432	0.0864	0.0864	0	24
25	0.176	0.0605	1.86	1.38	3.00	0.626	0.292	0	0	0.0864	0.0864	0	25
26	4.85	0.0864	1.48	1.16	26.6	1.07	0.148	0	0	0.0864	0.0864	0	26
27	3.19	0.0864	1.59	0.889	3.83	4.07	0.130	0	0	0.0720	0.115	0	27
28	2.59	0.0864	10.4	0.714	1.70	1.67	0.0864	0	0	0.0540	0.292	0	28
29	6.51		21.5	0.608	1.09	0.508	0.0648	0	0	0	0.155	0	29
30	12.4		7.26	0.400	5.57	0.248	0.0468	0	0	0	0.119	0	30
31	7.83		4.96		85.2		0	0		0.0540		0.130	31
TOTAL	46.1#	12.3	66.7	162	130	256	85.1	0.212	5.62	2.29	14.3	0.612	TOTAL
MEAN	2.10	0.440	2.15	5.42	4.20	8.55	2.75	0.0069	0.187	0.0739	0.476	0.0197	MEAN
ST.D.	3.16	1.06	4.27	8.47	15.8	16.3	12.5	0.0231	0.446	0.146	1.34	0.0363	ST.D.
MAX	12.4	5.50	21.5	38.9	85.2	71.3	69.6	0.101	2.40	0.677	6.87	0.130	MAX
MIN	0.140	0.0432	0	0.400	0.0108	0.158	0	0	0	0	0	0	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 782
DRAINAGE AREA (hectares), 435.0

/charge/4100./data/loads/fi.flo[illegible] .992

TOTAL DAILY DISCHARGE FOR 1990 Essex Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	1.00	0.346	3.61	0.0864	0	0.0252	0	0	0.0216	0	0.749	1
2	0	30.8	1.12	8.45	0.0612	0.0036	0	0	0	0	0	0.490	2
3	0	7.51	0.864	7.59	0.0036	0.169	0	0	0	0	0	107	3
4	2.25	3.78	0.691	7.21	7.98	0.428	0	0	0	0.572	0.0072	41.2	4
5	10.6	2.38	0.518	3.33	10.2	0.0324	0	0	0	0.702	22.6	4.85	5
6	3.86	8.38	0.346	1.94	2.74	0	0	0	19.1	0.151	20.6	2.61	6
7	2.00	18.2	0.173	1.59	1.38	0	0	0	164	0.0864	4.32	2.21	7
8	1.90	11.4	0.354	1.38	0.842	17.0	0	0	10.4	0.223	1.99	1.78	8
9	4.13	6.59	16.0	1.05	0.623	0.623	0	0	0.202	108	1.34	1.49	9
10	15.1	3.75	22.2	27.8	0.637	0.166	0	0	0.630	158	1.48	1.54	10
11	5.07	1.98	21.1	18.7	0.198	0.0864	0	0	0.374	67.2	0.965	0.940	11
12	3.53	0.527	12.1	6.30	0.0864	0.101	0	0.205	0.130	10.6	0.536	0.875	12
13	1.95	0.484	5.16	3.61	16.8	0.0864	0	2.69	0.0864	7.11	0.220	0.680	13
14	1.34	0.346	3.27	8.08	4.64	0.0864	2.16	0.266	26.2	3.93	0.173	0.227	14
15	0.760	1.18	2.06	5.51	2.38	0.0864	0.770	0.0108	21.3	1.81	0.155	0.526	15
16	0.860	6.44	2.72	3.15	28.1	0.0216	0.0072	0	59.1	0.961	0.205	1.17	16
17	22.1	7.06	2.47	2.21	13.2	0	0	0	5.79	0.698	0.202	1.04	17
18	36.2	4.71	1.13	1.22	4.72	0	0	0.194	0.331	29.5	0.0900	6.24	18
19	7.20	6.69	0.864	1.06	1.82	0	0	27.1	48.9	6.42	0.0864	8.72	19
20	2.47	5.13	0.810	2.92	1.27	0	0	1.93	8.67	2.53	0.0864	3.13	20
21	1.49	3.92	0.767	12.5	0.601	0	0	0.558	1.80	1.44	0.0864	23.4	21
22	1.13	204	0.860	4.18	0.241	0	0	0.464	4.24	0.907	2.62	21.9	22
23	1.69	71.6	1.00	2.53	0.137	0	0	0.108	1.18	0.565	2.05	11.7	23
24	12.7	12.1	0.623	1.46	0.0936	0	0	0.0864	0.616	0.385	1.57	4.05	24
25	11.3	2.14	0.518	1.06	0.0864	0	0	0	0.360	0.184	0.950	20.4	25
26	4.79	5.89	0.346	0.724	0.0864	0	0	0	0.191	0.0864	0.457	16.6	26
27	1.03	5.11	0.140	0.515	0.0864	0.155	0	0	0.101	0.0864	2.45	12.1	27
28	1.15	2.98	0.115	0.461	0.0828	1.17	0	0.266	0.0864	0.0864	10.3	19.6	28
29	0.657		0.140	0.256	0.0720	0.220	0	0.436	0.0864	0.0756	3.48	231	29
30	0.354		0.443	0.119	0	0.0828	0.0576	0.0324	0.0864	0	1.18	175	30
31	0.225		0.900		0		0.0108	0		0		15.2	31
TOTAL	157	436	100	140	99.2	20.5	3.03	34.3	374	403	80.1	740	TOTAL
MEAN	5.09	15.6	3.23	4.69	3.20	0.683	0.0977	1.11	12.5	13.0	2.67	23.9	MEAN
ST.D.	7.76	39.5	6.01	5.98	6.22	3.09	0.406	4.85	32.2	35.3	5.53	52.6	ST.D.
MAX	36.2	204	22.2	27.8	28.1	17.0	2.16	27.1	164	158	22.6	231	MAX
MIN	0	0.346	0.115	0.119	0	0	0	0	0	0	0	0.227	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 2591
DRAINAGE AREA (hectares), 435.0

/charge/4100./data/loads/fi.flow ut Tue Oct 20 10:20:11 1992

TOTAL DAILY DISCHARGE FOR 1991 Essex Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	3.78	0	1.47	0.187	0.251	58.3	0	0	0	0	0.138	2.66	1
2	1.93	0.0792	15.7	0.115	0.207	12.2	0	0	0	0	0.251	0.665	2
3	0.752	1.74	10.3	0.0864	0.130	7.34	0	0	0	0	0.156	12.4	3
4	0.662	3.37	2.70	0.101	0.112	2.85	0	0	0	0.0086	0.0518	5.13	4
5	0.259	4.56	3.55	0.241	0.138	0.467	0	0	0	0.0086	0.0346	1.52	5
6	0.245	1.52	18.0	0.173	0.311	0.276	0	0	0	0.0086	0.0259	0.631	6
7	0.119	1.00	5.62	0.180	0.181	0.207	0	0	0	0	0.0259	6.66	7
8	0.0864	0.958	1.88	0.677	0.121	0.173	0	0	0	0	0.0173	7.59	8
9	0.0864	0.673	1.38	7.00	0.130	0.173	0	0	0	0	0.0173	4.25	9
10	0.0864	0.562	1.05	2.11	0.173	0.147	0	0	0	0.0086	0.0173	1.78	10
11	1.68	0.306	0.688	0.439	0.164	0.181	0	0	0	0.0173	0.0173	0.631	11
12	3.67	0.173	0.382	0.288	0.199	0.164	0	0	0	0.0173	0.0259	0.579	12
13	0.742	0.187	0.371	0.378	0.320	0.0864	0	0	0	0.0173	0.0259	2.89	13
14	0.752	0.144	0.281	0.482	0.363	0.0605	0	0	0	0.0173	0.0173	1.91	14
15	6.58	0.0288	0.166	1.08	0.259	1.05	0	0	0	0.0173	0.0259	0.415	15
16	43.2	0	0.0936	0.583	0.207	3.49	0	0	0	0.0173	0.0518	0.207	16
17	17.6	0	0.133	0.371	0.268	0.259	0	0	0	0.0173	0.0346	0.251	17
18	4.59	0	0.932	0.292	0.242	0.112	0	0	0	0.0173	0.0864	0.156	18
19	4.97	41.3	0.616	23.5	0.147	0.0518	0	0	0	0.0259	1.30	0.0518	19
20	13.4	30.5	0.385	94.9	0.104	0.0432	0	0	0	0.0259	19.0	0.0432	20
21	5.14	16.6	0.349	21.8	0.104	0.0259	0	0	0	0.0173	18.9	0.0950	21
22	3.91	16.4	0.310	7.69	0.0691	0.0259	0	0	0	0.0086	5.20	0.112	22
23	0.421	10.9	0.331	2.46	0.0605	0.0259	0	0	0	0.0086	2.55	0.216	23
24	0.209	2.75	0.299	3.62	0.0864	0.0259	0	0	0	0.104	2.75	0.302	24
25	0.0864	2.24	0.119	1.80	0.199	0.0173	0	0	0	2.20	0.415	0.216	25
26	0.0864	1.16	0.0864	0.968	29.1	0.0173	0	0	0	7.06	0.190	0.112	26
27	0.0864	1.17	0.324	0.569	7.72	0.0086	0	0	0	8.99	0.138	0.104	27
28	0.0720	0.346	2.32	0.472	3.44	0	0	0	0	3.02	0.164	0.104	28
29	0.0108		0.482	0.382	1.34	0	0	0	0	0.276	5.41	2.57	29
30	0		0.234	0.245	2.17	0	0	0	0	0.138	6.11	8.90	30
31	0		0.176		6.60		0	0		0.164		3.99	31
TOTAL	115	138	70.7	173	54.9	87.8	0	0	0	22.2	63.2	67.2	TOTAL
MEAN	3.72	4.95	2.28	5.77	1.77	2.93	0	0	0	0.716	2.11	2.17	MEAN
ST.D.	8.36	9.94	4.41	17.8	5.39	10.8	0	0	0	2.07	4.90	3.08	ST.D.
MAX	43.2	41.3	18.0	94.9	29.1	58.3	0	0	0	8.99	19.0	12.4	MAX
MIN	0	0	0.0864	0.0864	0.0605	0	0	0	0	0	0.0173	0.0432	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 793
DRAINAGE AREA (hectares), 435.0

/charge/4100./data/loads/fi.flow92.out Mon Nov 2 15:48:53 1992

TOTAL DAILY DISCHARGE FOR 1992 Essex Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1.73	0.986	2.86	12.9	2.10	0.410	---	---	---	---	---	---	1
2	1.72	0.871	2.78	4.38	1.63	0.324	---	---	---	---	---	---	2
3	12.9	0.796	2.25	2.71	0.983	0.310	---	---	---	---	---	---	3
4	5.97	0.756	2.08	2.39	0.760	0.349	---	---	---	---	---	---	4
5	2.74	0.630	1.81	1.25	0.576	0.385	---	---	---	---	---	---	5
6	1.91	0.626	2.36	1.12	0.360	0.281	---	---	---	---	---	---	6
7	1.21	0.698	35.9	1.22	0.259	0.486	---	---	---	---	---	---	7
8	0.983	0.598	15.1	0.947	0.338	0.403	---	---	---	---	---	---	8
9	1.11	0.378	5.97	0.792	0.554	0.216	---	---	---	---	---	---	9
10	1.09	0.346	29.8	0.745	0.338	0.173	---	---	---	---	---	---	10
11	0.810	0.346	6.29	0.850	0.216	0.122	---	---	---	---	---	---	11
12	0.662	0.302	2.73	0.641	0.270	0.0864	---	---	---	---	---	---	12
13	1.79	0.292	1.71	0.346	0.302	0.0864	---	---	---	---	---	---	13
14	4.32	0.284	1.27	0.371	0.202	0.0864	---	---	---	---	---	---	14
15	0.691	19.4	0.911	0.428	0.130	0.0864	---	---	---	---	---	---	15
16	0.605	58.3	0.781	3.78	0.0864	0.0864	---	---	---	---	---	---	16
17	0.518	48.4	1.51	7.03	0.115	0.241	---	---	---	---	---	---	17
18	0.432	37.2	1.59	12.4	0.112	8.96	---	---	---	---	---	---	18
19	0.346	103	1.34	7.28	0.0864	1.68	---	---	---	---	---	---	19
20	0.346	52.7	0.958	3.73	0.0864	0.713	---	---	---	---	---	---	20
21	0.346	32.8	0.810	24.0	0.0864	0.331	---	---	---	---	---	---	21
22	0.864	19.1	1.13	10.6	0.0576	0.216	---	---	---	---	---	---	22
23	9.59	17.8	1.07	8.15	5.03	0.230	---	---	---	---	---	---	23
24	13.8	8.11	1.43	38.4	6.42	0.331	---	---	---	---	---	---	24
25	6.91	8.93	16.5	19.9	1.45	0.220	---	---	---	---	---	---	25
26	3.46	6.43	28.5	10.6	0.821	0.248	---	---	---	---	---	---	26
27	1.90	4.29	37.0	3.86	0.472	0.263	---	---	---	---	---	---	27
28	1.47	6.13	8.26	2.18	0.310	0.180	---	---	---	---	---	---	28
29	1.30	4.45	4.00	1.64	0.216	0.104	---	---	---	---	---	---	29
30	1.09		5.09	2.97	0.522	0.0864	---	---	---	---	---	---	30
31	1.11		4.24		0.594		---	---		---		---	31
TOTAL	83.7	435	228	187	25.5	17.7	---	---	---	---	---	---	TOTAL
MEAN	2.70	15.0	7.36	6.25	0.822	0.590	---	---	---	---	---	---	MEAN
ST.D.	3.54	24.3	10.7	8.47	1.41	1.61	---	---	---	---	---	---	ST.D.
MAX	13.8	103	37.0	38.4	6.42	8.96	---	---	---	---	---	---	MAX
MIN	0.346	0.284	0.781	0.346	0.0576	0.0864	---	---	---	---	---	---	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 978
DRAINAGE AREA (hectares), 435.0

SUB-WATERSHED DAILY DISCHARGE

ESSEX CONTROL

TOTAL DAILY DISCHARGE FOR 1989 Essex Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	3.86	0.0346	2.58	0.259	20.6	0.180	0	0.0468	0	0.0864	0.151	1
2	---	1.26	0.0072	2.12	0.313	21.1	0.144	0	0.0036	0	0.0864	0.144	2
3	---	0.536	0	25.1	0.270	23.4	0.169	0	0	0	0.0360	0.0900	3
4	---	0.259	0.0576	16.8	0.187	12.3	0.115	0.0288	0	0	0	0.0864	4
5	---	0.173	0.173	8.49	0.270	4.38	0.0864	0.0648	0	0	0	0.0864	5
6	---	0.156	0.0778	5.57	0.238	2.05	0.0828	0	0	0	0.0324	0.0864	6
7	---	0.138	0.0259	3.91	0.173	0.896	0.0360	0	0.0396	0	0.0756	0.0605	7
8	---	0.121	0.0288	2.69	0.133	0.526	0.0360	0	0.0792	0	0.0864	0.0108	8
9	---	0.121	0.0648	1.54	0.0972	0.450	0	0	0.0792	0	0.0864	0.0518	9
10	1.38	0.104	0.0864	0.781	0.0864	0.292	0	0	0.0864	0.0252	0.140	0.0468	10
11	0.432	0.104	0.245	0.648	0.0864	0.173	0	0	0.0864	0	0.166	0.0864	11
12	1.12	0.0864	0.281	0.814	0.112	0.238	0	0	0.0144	0	0.0864	0.0778	12
13	0.594	0.173	0.0900	1.22	0.173	0.266	0	0	0	0	0.0864	0.0432	13
14	0.227	0.259	0.151	1.29	0.0900	0.173	0	0	0.0432	0	0.0864	0.0346	14
15	0.540	0.173	0.216	3.62	0.0864	0.112	0	0	0.0864	0	1.11	0.0259	15
16	0.216	0.156	0.0864	2.65	0.0864	3.01	0	0	0.122	0	4.16	0.0173	16
17	0.187	0.138	0.0864	8.42	0.0864	1.39	0	0	0.677	0	1.06	0.0086	17
18	0.234	0.121	3.12	10.6	0.0864	3.05	0	0	0.162	0	0.655	0	18
19	0.353	0.104	2.65	5.06	0.0864	40.7	0.266	0	0.0864	0.144	0.371	0	19
20	0.346	0.112	1.38	3.17	0.220	18.0	56.7	0	0.0864	0.655	0.338	0	20
21	0.0864	0.173	1.42	2.66	0.133	2.62	6.94	0	0.0216	0.601	0.205	0	21
22	0.0864	0.0864	1.99	1.88	0.0864	1.70	1.16	0	0.0468	0.313	0.104	0	22
23	0.137	0.0691	1.88	1.33	0.0864	1.10	0.432	0	0.0324	0.173	0.0864	0	23
24	0.173	0.0396	1.97	1.01	0.0864	0.688	0.184	0	0	0.158	0.0864	0	24
25	0.130	0	1.66	1.24	2.03	0.497	0.0864	0	0	0.0864	0.0864	0	25
26	4.41	0.0324	0.968	1.19	13.8	1.08	0.0864	0	0	0.0864	0.0864	0	26
27	2.86	0.0864	1.67	0.850	3.12	7.97	0.0864	0	0	0.0864	0.0972	0	27
28	2.17	0.0864	8.58	0.601	1.20	2.00	0.0972	0	0	0.0864	0.119	0	28
29	6.49		12.6	0.497	0.734	0.400	0.0540	0	0	0.0864	0.0864	0	29
30	10.2		5.95	0.342	4.17	0.223	0	0	0	0.0864	0.169	0	30
31	6.14		4.22		49.6		0	0		0.0864		0.173	31
TOTAL	38.5#	8.72	51.7	118	78.2	171	66.9	0.0936	1.80	2.67	9.88	1.28	TOTAL
MEAN	1.75	0.311	1.67	3.96	2.52	5.71	2.16	0.0030	0.0600	0.0863	0.329	0.0413	MEAN
ST.D.	2.70	0.732	2.81	5.39	9.11	9.64	10.2	0.0126	0.125	0.162	0.774	0.0508	ST.D.
MAX	10.2	3.86	12.6	25.1	49.6	40.7	56.7	0.0648	0.677	0.655	4.16	0.173	MAX
MIN	0.0864	0	0	0.342	0.0864	0.112	0	0	0	0	0	0	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 549
DRAINAGE AREA (hectares), 281.0

TOTAL DAILY DISCHARGE FOR 1990 Essex Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1.11	1.40	0.251	2.13	0.299	0.0864	0.461	0	0.0468	0.0864	0.173	1.89	1
2	0.346	29.8	0.562	3.33	0.212	0.101	0.191	0	0	0.0864	0.180	0.994	2
3	0.665	8.78	1.19	2.89	0.173	0.925	0.0864	0	0	0.0864	0.194	54.7	3
4	4.34	4.58	0.363	2.89	5.41	1.18	0.0864	0	0	2.52	0.227	38.3	4
5	5.88	2.99	0.173	1.41	4.28	0.371	0.0864	0	0	2.77	15.6	10.00	5
6	2.93	9.26	0.147	0.968	1.04	0.328	0.0432	0	12.9	0.731	23.5	5.31	6
7	2.13	16.6	0.156	0.868	0.817	0.374	0	0	117	0.396	7.78	4.60	7
8	2.05	10.2	1.26	0.792	0.677	16.5	0	0	11.5	0.382	3.80	3.73	8
9	3.20	6.14	14.5	0.860	0.572	5.42	0	0	3.03	42.7	2.73	3.40	9
10	11.3	3.95	19.7	14.8	0.680	1.43	0	0	0.443	80.6	3.00	2.96	10
11	3.78	2.43	16.3	8.92	0.396	0.749	0	0	0.104	52.9	2.04	2.31	11
12	2.46	0.527	10.7	2.38	0.270	0.698	0	0.0252	0.0864	21.8	1.05	2.22	12
13	0.691	0.536	5.51	1.64	18.2	0.738	0	0.270	0.0864	15.4	0.634	1.66	13
14	0.605	0.328	3.62	3.48	4.24	0.706	5.19	0.0756	40.9	10.2	0.518	0.760	14
15	0.518	3.30	2.46	2.22	1.90	0.670	0.745	0.0684	18.8	5.76	0.536	1.24	15
16	0.700	7.98	2.83	1.50	21.6	0.414	0.115	0	66.4	2.58	0.641	1.68	16
17	15.7	7.73	2.96	1.22	10.0	0.346	0.0576	0	10.5	2.03	0.547	1.23	17
18	29.8	6.58	1.43	0.792	1.80	0.331	0.0180	0.0792	4.70	20.3	0.331	6.89	18
19	10.5	7.84	1.07	0.749	0.961	0.306	0.0036	8.78	22.8	12.4	0.317	12.6	19
20	3.64	7.65	1.05	1.74	0.770	0.259	0.0072	0.763	9.58	5.48	0.270	5.61	20
21	1.99	4.94	0.896	5.97	0.529	0.986	0	0.148	5.50	3.38	0.230	16.7	21
22	1.30	118	0.972	1.80	0.432	0.749	0.0468	0.112	7.07	2.12	1.48	22.5	22
23	1.79	50.6	0.889	1.31	0.382	2.69	0.0864	0.0540	1.40	1.50	2.16	17.0	23
24	12.4	16.6	0.572	1.00	0.353	1.86	0.0432	0.0432	0.572	0.979	2.67	11.4	24
25	12.4	5.18	0.565	0.821	0.295	0.598	0	0.0864	0.378	0.641	1.48	5.90	25
26	5.56	1.12	0.493	0.670	0.310	0.302	0	0.0540	0.220	0.396	0.760	4.67	26
27	2.70	0.691	0.346	0.641	0.281	0.155	0	0	0.0864	0.328	2.08	9.07	27
28	2.40	0.432	0.295	0.680	0.259	5.33	0	0.0252	0.0864	0.302	10.0	8.33	28
29	1.74		0.274	0.518	0.227	3.24	0	0.0864	0.0864	0.209	5.26	114	29
30	1.08		0.407	0.346	0.173	0.778	0	0.0864	0.0864	0.173	2.53	102	30
31	0.630		0.562		0.137		0	0.0864		0.173		20.0	31
TOTAL	146	336	92.5	69.4	77.6	48.7	7.27	10.8	334	289	92.7	495	TOTAL
MEAN	4.72	12.0	2.98	2.31	2.50	1.62	0.234	0.350	11.2	9.34	3.09	16.0	MEAN
ST.D.	6.24	23.4	5.10	2.95	5.10	3.13	0.933	1.57	24.6	18.2	5.12	27.4	ST.D.
MAX	29.8	118	19.7	14.8	21.6	16.5	5.19	8.78	117	80.6	23.5	114	MAX
MIN	0.346	0.328	0.147	0.346	0.137	0.0864	0	0	0	0.0864	0.173	0.760	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 2001
DRAINAGE AREA (hectares), 281.0

TOTAL DAILY DISCHARGE FOR 1991 Essex Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	2.62	0	0.367	0.156	0.121	19.0	0	0	0	0	0.207	0.510	1
2	1.02	0	10.9	0.0950	0.0864	3.54	0	0	0	0	0.346	0.302	2
3	0.616	0.630	6.19	0.0605	0.0346	1.30	0	0	0	0	0.173	5.58	3
4	0.526	1.78	1.44	0.0778	0.0086	0.320	0	0	0	0	0.112	2.45	4
5	0.454	2.17	1.05	0.156	0.104	0.164	0	0	0	0	0.0950	0.518	5
6	0.310	0.716	12.5	0.156	0.579	0.104	0	0	0	0	0.0864	0.397	6
7	0.122	0.576	2.71	0.164	0.138	0.0778	0	0	0	0	0.0778	3.16	7
8	0.104	0.594	0.648	2.77	0.0691	0.0778	0	0	0	0	0.0778	4.15	8
9	0.173	0.508	0.439	7.54	0.0691	0.0950	0	0	0	0	0.0691	2.05	9
10	0.0864	0.446	0.392	0.942	0.0778	0.0950	0	0	0	0	0.0778	0.683	10
11	0.817	0.238	0.266	0.294	0.104	0.130	0	0	0	0	0.0864	0.449	11
12	2.97	0.0864	0.238	0.181	0.181	0.112	0	0	0	0	0.0778	0.423	12
13	1.05	0.0972	0.230	0.251	0.397	0.0864	0	0	0	0	0.0864	1.14	13
14	0.518	0.137	0.158	0.285	0.380	0.0518	0	0	0	0	0.0778	0.795	14
15	5.66	0.389	0.0864	0.501	0.199	0.855	0	0	0	0	0.112	0.406	15
16	27.7	0.270	0.0864	0.311	0.121	4.74	0	0	0	0	0.0950	0.294	16
17	14.1	0	0.0864	0.216	0.251	0.337	0	0	0	0	0.104	0.320	17
18	2.94	0	0.580	0.173	0.173	0.164	0	0	0	0	0.130	0.285	18
19	2.63	22.7	0.486	14.3	0.0605	0.104	0	0	0	0	0.432	0.173	19
20	10.5	33.1	0.324	67.3	0.0173	0.0864	0	0	0	0	4.91	0.130	20
21	7.94	24.6	0.259	16.7	0.0259	0.0778	0	0	0	0	4.78	0.181	21
22	0.720	14.3	0.194	4.55	0.0778	0.0691	0	0	0	0	0.881	0.225	22
23	0.565	9.94	0 248	1.15	0.121	0.0605	0	0	0	0	0.337	0.320	23
24	0.256	0.616	0.205	1.64	0.285	0.0259	0	0	0	0.147	0.441	0.389	24
25	0.148	0.526	0.0864	0.752	0.942	0.0086	0	0	0	0.665	0.233	0.276	25
26	0.0864	0.302	0.0864	0.536	12.0	0	0	0	0	2.04	0.156	0.199	26
27	0.0864	0.216	0.248	0.389	2.69	0	0	0	0	1.15	0.138	0.199	27
28	0.0648	0.137	1.77	0.268	0.760	0	0	0	0	0.328	0.138	0.199	28
29	0		0.457	0.181	0.544	0	0	0	0	0.173	1.02	1.89	29
30	0		0.220	0.147	0.821	0	0	0	0	0.138	1.59	5.74	30
31	0		0.173		1.33		0	0		0.164		2.71	31
TOTAL	84.8	114	43.1	122	22.8	31.7	0	0	0	4.80	17.1	36.5	TOTAL
MEAN	2.74	4.11	1.39	4.08	0.735	1.06	0	0	0	0.155	0.571	1.18	MEAN
ST.D.	5.71	8.72	2.99	12.6	2.16	3.55	0	0	0	0.424	1.21	1.57	ST.D.
MAX	27.7	33.1	12.5	67.3	12.0	19.0	0	0	0	2.04	4.91	5.74	MAX
MIN	0	0	0.0864	0.0605	0.0086	0	0	0	0	0	0.0691	0.130	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 478
DRAINAGE AREA (hectares), 281.0

/charge/4100./data/loads/se.flo . .n Nov 2 15:49:37 1992

TOTAL DAILY DISCHARGE FOR 1992 Essex Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1.01	0.806	1.94	7.30	1.72	0.0324	---	---	---	---	---	---	1
2	1.09	0.608	1.65	3.48	1.59	0	---	---	---	---	---	---	2
3	5.93	0.565	1.24	2.12	0.965	0	---	---	---	---	---	---	3
4	3.46	0.569	1.17	1.66	0.576	0.0180	---	---	---	---	---	---	4
5	1.82	0.371	1.06	0.965	0.443	0.0864	---	---	---	---	---	---	5
6	1.20	0.425	1.04	0.810	0.284	0.0468	---	---	---	---	---	---	6
7	0.727	0.526	18.7	0.922	0.184	0.0648	---	---	---	---	---	---	7
8	0.436	0.389	8.65	0.745	0.180	0.0468	---	---	---	---	---	---	8
9	0.691	0.270	3.75	0.482	0.209	0	---	---	---	---	---	---	9
10	0.410	0.198	22.2	0.421	0.126	0	---	---	---	---	---	---	10
11	0.324	0.173	5.26	0.551	0.0864	0.0432	---	---	---	---	---	---	11
12	0.270	0.173	2.44	0.317	0.0864	0.0864	---	---	---	---	---	---	12
13	0.873	0.173	1.64	0.180	0.0864	0.0864	---	---	---	---	---	---	13
14	4.41	0.173	1.30	0.209	0.0864	0.0864	---	---	---	---	---	---	14
15	1.81	11.7	0.792	0.238	0.0864	0.0864	---	---	---	---	---	---	15
16	1.04	27.2	0.580	0.810	0.0504	0.0864	---	---	---	---	---	---	16
17	0.691	22.9	1.24	2.41	0.0324	0.0396	---	---	---	---	---	---	17
18	0.432	19.4	1.07	5.43	0.0324	2.25	---	---	---	---	---	---	18
19	0.346	57.5	0.972	3.75	0	0.655	---	---	---	---	---	---	19
20	0.259	24.4	0.605	2.51	0	0.252	---	---	---	---	---	---	20
21	0.259	12.2	0.382	19.1	0	0.133	---	---	---	---	---	---	21
22	0.259	8.55	0.216	7.65	0	0.0864	---	---	---	---	---	---	22
23	2.76	8.43	0.605	5.96	1.28	0.0936	---	---	---	---	---	---	23
24	5.62	5.46	1.06	24.1	2.80	0.158	---	---	---	---	---	---	24
25	3.54	5.10	9.61	12.0	0.468	0.0864	---	---	---	---	---	---	25
26	1.81	4.14	14.8	6.33	0.194	0.0864	---	---	---	---	---	---	26
27	1.21	2.90	28.6	2.97	0.112	0.0864	---	---	---	---	---	---	27
28	1.04	3.61	6.35	1.76	0.0864	0.0864	---	---	---	---	---	---	28
29	1.16	2.94	3.13	1.45	0.0360	0.0612	---	---	---	---	---	---	29
30	0.994		3.42	1.86	0.0864	0	---	---	---	---	---	---	30
31	0.968		2.99		0.0864		---	---		---		---	31
TOTAL	46.8	221	148	118	12.0	4.84	---	---	---	---	---	---	TOTAL
MEAN	1.51	7.65	4.79	3.95	0.386	0.161	---	---	---	---	---	---	MEAN
ST.D.	1.54	12.5	7.02	5.59	0.641	0.411	---	---	---	---	---	---	ST.D.
MAX	5.93	57.5	28.6	24.1	2.80	2.25	---	---	---	---	---	---	MAX
MIN	0.259	0.173	0.216	0.180	0	0	---	---	---	---	---	---	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 552
DRAINAGE AREA (hectares), 281.0

SUB-WATERSHED DAILY DISCHARGE

KETTLE CREEK TEST

/charge/4100./data/loads/ma.flo

TOTAL DAILY DISCHARGE FOR 1989 Kettle Creek Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.598	5.47	0	2.28	0.259	0.943	0	0	0	0	0	0.454	1
2	0.461	1.39	0	2.07	0.266	5.43	0	0	0	0	0	0.457	2
3	0.320	0.893	0	22.3	0.212	1.57	0	0	0	0	0	0.342	3
4	0.227	0.702	5.05	18.5	0.173	1.39	0	0	0	0	0	0.259	4
5	0.169	0.371	8.28	10.3	0.313	0.533	0.0004	0	0	0	0	0.259	5
6	0.126	0.274	0.464	8.14	0.299	0.562	0	0	0	0	0.0180	0.173	6
7	0.225	0.187	0.112	3.97	0.292	0.392	0	0	0	0	1.15	0.140	7
8	21.5	0.144	0.0864	2.42	0.295	0.270	0	0	0	0	0.511	0.101	8
9	1.60	0.0504	0.410	2.11	0.220	0.173	0	0	0	0	1.49	0.101	9
10	0.706	0.0756	1.26	2.06	0.0972	0.162	0	0	0	0	0.360	0.140	10
11	0.328	0.0864	1.60	2.01	0.101	0.108	0	0	0	0	0.187	0.0864	11
12	3.95	0.0360	0.778	3.46	0.641	0.108	0	0	0	0	0.115	0.0864	12
13	0.619	0.0216	0.346	7.24	0.742	0.173	0	0	0	0	0.0864	0.0864	13
14	0.259	1.24	0.598	2.96	0.493	0.108	0	0	0	0	0.0864	0.0864	14
15	0.191	0.468	2.23	16.5	0.378	0.0864	0	0	0	0	4.73	0.0036	15
16	0.144	0.162	0.648	4.45	0.259	0.0864	0	0	0	0	13.8	0	16
17	0.122	0.0864	0.529	12.0	0.180	0.140	0	0	0	0	2.30	0	17
18	0.853	0.0864	40.0	10.7	0.115	0.230	0	0	0	0	0.875	0	18
19	0.598	0.0468	4.92	3.68	0.0864	1.27	0	0	0	0	0.522	0	19
20	0.173	0.0108	2.59	2.25	0.198	1.63	0	0	0	0	1.17	0	20
21	0.180	2.85	1.56	1.65	0.184	0.680	0	0	0	0.130	0.778	0	21
22	0.194	0.644	1.38	1.20	0.0864	4.18	0	0	0	0.126	0.497	0	22
23	0.788	0.0864	3.54	0.857	0.162	0.691	0	0	0	0.0288	0.331	0	23
24	1.07	0.0072	4.28	0.673	0.310	0.637	0	0	0	0	0.223	0	24
25	0.562	0	8.55	0.547	0.511	0.349	2.72	0	0	0	0.270	0	25
26	14.6	0	7.32	0.576	10.7	0.216	0.155	0	0	0	0.616	0	26
27	1.15	0	7.79	0.536	0.706	0.173	0.0036	0	0	0	0.482	0	27
28	0.770	0	15.5	0.439	0.565	0.122	0	0	0	0	4.37	0	28
29	4.54		12.0	0.364	0.385	0.0540	0	0	0	0	0.576	0	29
30	7.86		5.53	0.306	1.66	0	0	0	0	0	0.605	0	30
31	3.43		3.36		0.943		0	0		0		0.162	31
TOTAL	68.3	15.4	140	146	21.8	22.5	2.88	0	0	0.284	36.2	2.94	TOTAL
MEAN	2.20	0.550	4.54	4.88	0.704	0.749	0.0929	0	0	0.0092	1.21	0.0948	MEAN
ST.D.	4.64	1.14	7.63	5.83	1.88	1.21	0.489	0	0	0.0321	2.65	0.133	ST.D.
MAX	21.5	5.47	40.0	22.3	10.7	5.43	2.72	0	0	0.130	13.8	0.457	MAX
MIN	0.122	0	0	0.306	0.0864	0	0	0	0	0	0	0	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 457
DRAINAGE AREA (hectares), 410.0

TOTAL DAILY DISCHARGE FOR 1990 Kettle Creek Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.432	1.30	0.950	3.56	0.396	0.259	1.29	0.428	1.25	1.27	0.868	1.55	1
2	0.778	6.57	1.81	11.6	0.328	0.0864	0.756	0.238	0.756	1.03	0.806	1.45	2
3	1.12	4.06	5.44	7.82	0.288	1.12	0.468	0.137	0.479	0.853	0.788	15.6	3
4	4.92	2.76	1.73	4.63	0.468	0.864	0.266	0.0972	0.418	14.0	0.763	43.2	4
5	6.13	2.07	1.21	2.91	0.695	0.518	0.148	0.248	0.302	1.70	60.5	7.12	5
6	3.37	2.33	0.950	2.72	0.450	0.223	0.0648	0.133	5.18	1.13	35.2	4.50	6
7	2.59	5.36	0.778	2.07	0.389	0.0036	0	0.0432	12.4	1.39	7.30	4.08	7
8	2.76	43.6	0.691	1.74	0.295	4.34	0.436	0	3.12	1.48	5.22	5.72	8
9	4.49	85.2	11.9	1.54	0.223	2.04	22.4	0	1.67	47.7	5.16	8.69	9
10	7.52	17.1	15.8	20.2	0.245	1.18	1.20	0	1.24	30.2	8.14	8.70	10
11	8.38	6.39	34.4	16.7	0.216	0.778	0.821	0	0.893	50.1	4.47	3.76	11
12	5.27	4.15	37.3	4.24	0.126	0.587	0.468	0.0468	0.630	21.5	2.84	3.24	12
13	3.46	6.39	42.4	3.06	4.41	0.432	0.302	1.33	0.504	8.43	2.04	4.24	13
14	2.76	3.63	23.8	3.17	2.07	0.349	7.78	0.461	32.0	2.59	1.66	2.19	14
15	2.51	2.59	13.5	3.66	1.56	0.230	2.00	0.230	22.5	1.65	1.52	1.60	15
16	2.94	2.33	15.3	2.67	24.0	0.137	1.26	0.115	6.67	1.36	1.63	5.18	16
17	40.1	2.16	10.5	3.31	45.1	0.0864	0.918	0.0864	3.28	1.59	1.57	2.29	17
18	85.8	1.99	5.53	2.42	14.9	0.155	0.601	0.0396	1.98	55.3	1.40	22.3	18
19	14.3	1.73	5.53	1.96	6.31	0.0468	0.400	0.126	2.07	4.69	1.41	10.4	19
20	6.57	0.778	4.58	3.33	16.5	0	0.857	0.173	1.81	2.40	1.39	2.92	20
21	3.46	1.64	4.49	9.67	11.8	0	0.479	0.0864	1.52	2.17	1.17	10.5	21
22	3.02	154	7.43	3.32	5.01	0	0.421	0.0864	2.20	2.52	12.4	18.0	22
23	2.76	54.8	12.4	2.28	2.85	9.22	0.457	0.0684	1.51	2.19	4.29	15.6	23
24	12.0	15.7	2.34	1.81	1.73	3.72	0.331	0	2.47	1.85	2.42	3.46	24
25	24.5	2.85	1.92	1.48	1.30	1.74	0.220	0	1.57	1.64	2.28	1.47	25
26	15.3	2.07	1.73	1.24	1.12	1.28	0.144	0	1.42	1.43	1.83	1.12	26
27	6.91	1.56	1.48	0.940	0.864	1.15	0.0864	0.461	1.18	1.29	10.2	1.04	27
28	8.64	1.21	1.40	0.763	0.691	0.785	0.0468	172	0.943	1.18	13.8	1.04	28
29	3.80		1.35	0.580	0.778	0.623	0	26.3	0.839	1.06	3.86	138	29
30	2.42		3.33	0.482	0.518	2.39	1.98	6.15	1.18	1.03	1.85	62.2	30
31	1.56		3.11		0.432		0.526	1.96		0.950		10.8	31
TOTAL	290	437	275	125	146	34.3	47.1	211	113	267	198	422	TOTAL
MEAN	9.37	15.6	8.87	4.19	4.71	1.14	1.52	6.83	3.80	8.64	6.62	13.6	MEAN
ST.D.	16.3	33.4	11.3	4.63	9.43	1.86	4.12	31.2	6.91	15.6	12.2	26.5	ST.D.
MAX	85.8	154	42.4	20.2	45.1	9.22	22.4	172	32.0	55.3	60.5	138	MAX
MIN	0.432	0.778	0.691	0.482	0.126	0	0	0	0.302	0.853	0.763	1.04	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 2570
DRAINAGE AREA (hectares), 410.0

TOTAL DAILY DISCHARGE FOR 1991 Kettle Creek Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	3.28	0.0864	3.46	1.51	0.518	0.708	0	0	0	0	0	2.06	1
2	2.07	0.259	34.6	1.33	0.475	0.415	0	0	0	0	0	0.795	2
3	1.73	1.30	10.4	1.14	0.389	0.242	0	0	0	0	0	0.743	3
4	1.30	6.91	3.02	1.08	0.302	0.112	0	0	0	0	0	0.527	4
5	1.12	11.1	6.91	1.31	0.285	0.0691	0	0	0	0	0	0.225	5
6	0.950	6.22	43.2	1.52	0.363	0.0605	0	0	0	0	0	0.190	6
7	0.778	5.53	10.4	1.53	0.294	0.0518	0	0	0	0	0	9.68	7
8	0.691	4.75	1.38	1.32	0.207	0.0346	0	0	0	0	0	34.6	8
9	0.605	2.59	1.04	6.89	0.320	0.0259	0	0	0	0	0	19.6	9
10	0.518	1.47	0.950	5.61	0.311	0.0259	0	0	0	0	0	5.42	10
11	0.432	1.04	0.691	1.81	0.259	0.0950	0	0	0	0	0	2.49	11
12	0.346	0.864	0.605	1.48	0.225	0.0605	0	0	0	0	0	2.19	12
13	0.259	0.778	0.864	1.40	0.207	0.0259	0	0	0	0	0	5.17	13
14	0.259	0.691	1.56	1.37	0.173	0.0346	0	0	0	0	0	3.20	14
15	0.259	0.605	1.63	9.24	0.138	0.0259	0	0	0	0	0	1.56	15
16	2.33	0.518	1.77	3.46	0.112	0.0346	0	0	0	0	0	0.769	16
17	5.53	0.432	1.93	1.78	0.164	0.0346	0	0	0	0	0	0.605	17
18	4.32	0.432	20.1	1.39	0.0864	0.0259	0	0	0	0	0	0.372	18
19	3.37	17.3	10.0	2.84	0.0691	0.0259	0	0	0	0	0	0.173	19
20	5.88	20.7	3.59	23.6	0.0605	0.0173	0	0	0	0	4.84	0.225	20
21	2.59	24.2	3.21	10.4	0.0518	0	0	0	0	0	3.91	0.337	21
22	1.56	15.6	2.34	5.17	0.0518	0	0	0	0	0	0.501	0.337	22
23	0.778	4.32	5.99	2.00	0.0432	0	0	0	0	0	0.199	0.354	23
24	0.518	2.59	7.95	1.76	0.0259	0	0	0	0	0.0864	0.242	0.311	24
25	0.346	1.90	3.98	1.57	0.0259	0	0	0	0	0.190	0.0778	0.242	25
26	0.259	1.47	2.43	1.40	7.07	0	0	0	0	0	0.0432	0.190	26
27	0.259	1.21	17.9	1.11	1.51	0	0	0	0	0.233	0.0346	0.216	27
28	0.173	1.04	10.8	0.899	0.899	0	0	0	0	0	0.0605	0.190	28
29	0.173		2.65	0.683	0.596	0	0	0	0	0	16.3	0.380	29
30	0.0864		1.62	0.527	2.30	0	0	0	0	0	11.0	0.804	30
31	0.0864		1.46		2.01		0	0		0		0.510	31
TOTAL	42.9	135	218	97.1	19.5	2.13	0	0	0	0.510	37.2	94.4	TOTAL
MEAN	1.38	4.85	7.04	3.24	0.630	0.0708	0	0	0	0.0164	1.24	3.05	MEAN
ST.D.	1.59	6.69	9.88	4.56	1.32	0.147	0	0	0	0.0547	3.62	7.01	ST.D.
MAX	5.88	24.2	43.2	23.6	7.07	0.708	0	0	0	0.233	16.3	34.6	MAX
MIN	0.0864	0.0864	0.605	0.527	0.0259	0	0	0	0	0	0	0.173	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 647
DRAINAGE AREA (hectares), 410.0

TOTAL DAILY DISCHARGE FOR 1992 Kettle Creek Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.353	0.864	11.7	3.21	1.43	0.0576	---	---	---	---	---	---	1
2	0.295	0.778	9.31	1.88	1.48	0	---	---	---	---	---	---	2
3	0.598	0.691	7.67	1.81	1.57	0	---	---	---	---	---	---	3
4	7.17	0.605	8.27	1.75	1.38	0	---	---	---	---	---	---	4
5	14.9	0.518	8.83	1.55	1.27	0	---	---	---	---	---	---	5
6	5.93	0.432	13.3	1.44	1.23	0	---	---	---	---	---	---	6
7	2.18	0.432	26.2	1.49	1.03	0.0504	---	---	---	---	---	---	7
8	1.22	0.432	22.9	1.39	0.803	0.115	---	---	---	---	---	---	8
9	2.06	0.346	9.04	1.23	0.644	0.0144	---	---	---	---	---	---	9
10	4.17	0.346	15.7	1.11	0.497	0	---	---	---	---	---	---	10
11	1.46	0.259	3.39	1.74	0.400	0	---	---	---	---	---	---	11
12	1.70	0.259	1.38	1.62	0.310	0	---	---	---	---	---	---	12
13	12.2	0.259	1.12	1.42	0.252	0	---	---	---	---	---	---	13
14	39.7	0.259	1.04	1.32	0.173	0	---	---	---	---	---	---	14
15	17.3	8.64	0.950	1.21	0.144	0	---	---	---	---	---	---	15
16	3.46	51.8	0.864	45.7	0.0864	0	---	---	---	---	---	---	16
17	1.73	43.2	0.778	18.0	0.0864	0	---	---	---	---	---	---	17
18	1.04	12.6	0.691	8.73	0.0864	0.0612	---	---	---	---	---	---	18
19	0.864	69.1	0.691	4.58	0.0684	0.846	---	---	---	---	---	---	19
20	0.778	33.1	0.691	2.79	0.0396	0.360	---	---	---	---	---	---	20
21	0.691	18.6	0.605	5.91	0	0.223	---	---	---	---	---	---	21
22	0.691	17.2	0.605	4.30	0.0540	0.0900	---	---	---	---	---	---	22
23	37.0	23.4	0.605	2.58	0.0468	0.0864	---	---	---	---	---	---	23
24	59.0	13.7	1.21	27.7	0.0720	0.101	---	---	---	---	---	---	24
25	17.8	10.0	2.70	11.0	0	0.0864	---	---	---	---	---	---	25
26	6.11	8.80	8.90	5.68	0	0.0864	---	---	---	---	---	---	26
27	2.37	11.6	4.88	3.66	0	0.0648	---	---	---	---	---	---	27
28	1.45	16.4	1.58	2.20	0	0.0072	---	---	---	---	---	---	28
29	1.21	7.78	1.49	1.50	0	0	---	---	---	---	---	---	29
30	1.04		2.12	1.65	0	0	---	---	---	---	---	---	30
31	0.950		2.10		0.0936		---	---		---		---	31
TOTAL	247	352	171	170	13.2	2.25	---	---	---	---	---	---	TOTAL
MEAN	7.98	12.2	5.52	5.68	0.427	0.0750	---	---	---	---	---	---	MEAN
ST.D.	13.7	17.3	6.69	9.48	0.543	0.166	---	---	---	---	---	---	ST.D.
MAX	59.0	69.1	26.2	45.7	1.57	0.846	---	---	---	---	---	---	MAX
MIN	0.295	0.259	0.605	1.11	0	0	---	---	---	---	---	---	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 956
DRAINAGE AREA (hectares), 410.0

SUB-WATERSHED DAILY DISCHARGE

KETTLE CREEK CONTROL

/charge/4100./data/loads/h>.flow89.out Tue Oct 20 11:02:16 1992

TOTAL DAILY DISCHARGE FOR 1989 Kettle Creek Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1.09	2.78	0.0864	3.78	0.270	0.374	0	0	0	0	0	0.792	1
2	0.842	1.44	0.0684	3.59	0.320	1.42	0	0	0	0	0	0.752	2
3	0.590	0.911	0	13.9	0.266	0.796	0	0	0	0	0	0.598	3
4	0.356	0.562	2.05	11.4	0.259	1.14	0	0	0	0	0	0.385	4
5	0.259	0.364	4.86	5.72	0.396	0.403	0	0	0	0	0	0.346	5
6	0.281	0.313	0.986	4.81	0.317	0.277	0	0	0	0	0	0.259	6
7	0.796	0.259	0.540	2.56	0.259	0.173	0	0	0	0	0	0.281	7
8	18.4	0.173	0.256	1.83	0.259	0.112	0	0	0	0	0	0.259	8
9	2.52	0.0972	0.403	1.51	0.216	0.0864	0	0	0	0	0	0.173	9
10	0.918	0.0684	1.63	1.44	0.180	0.0720	0	0	0	0	0	0.173	10
11	0.504	0.0504	1.80	1.40	0.227	0.0216	0	0	0	0	0	0.155	11
12	3.16	0.0180	1.38	1.95	0.644	0.0180	0	0	0	0	0	0.0864	12
13	1.32	0.0180	0.965	3.48	0.698	0.0864	0	0	0	0	0	0.0864	13
14	0.500	1.40	1.10	2.00	0.439	0.0864	0	0	0	0	0	0.0648	14
15	0.371	0.515	2.64	11.0	0.346	0.0864	0	0	0	0	0.238	0.0720	15
16	0.288	0.256	1.01	2.87	0.259	0.0864	0	0	0	0	5.51	0.0180	16
17	0.259	0.173	0.835	7.98	0.173	0.115	0	0	0	0	2.05	0	17
18	0.846	0.122	60.6	5.53	0.151	0.130	0	0	0	0	1.05	0	18
19	1.12	0.0864	8.64	2.35	0.104	0.421	0	0	0	0	0.734	0	19
20	0.518	0.0864	5.18	1.68	0.151	1.45	0	0	0	0	1.02	0	20
21	0.292	2.14	2.59	1.25	0.194	0.450	0	0	0	0	0.907	0	21
22	0.259	0.731	3.46	0.853	0.112	2.23	0	0	0	0	0.698	0	22
23	0.605	0.256	4.32	0.576	0.108	0.695	0	0	0	0	0.558	0	23
24	1.05	0.173	5.89	0.472	0.194	0.342	0	0	0	0	0.392	0	24
25	0.842	0.0864	8.40	0.436	0.209	0.223	6.90	0	0	0	0.472	0	25
26	10.3	0.0864	6.78	0.493	1.91	0.137	0.767	0	0	0	0.778	0	26
27	1.82	0.0864	7.20	0.425	0.418	0.0864	0.223	0	0	0	0.817	0	27
28	1.16	0.0864	14.6	0.346	0.248	0.0684	0.130	0	0	0	2.91	0	28
29	3.84		12.5	0.346	0.173	0	0.0396	0	0	0	1.36	0	29
30	4.69		6.34	0.328	0.436	0	0	0	0	0	1.01	0	30
31	2.38		4.71		0.364		0	0		0		0.983	31
TOTAL	62.2	13.3	171	96.4	10.3	11.6	8.06	0	0	0	20.5	5.48	TOTAL
MEAN	2.01	0.476	5.54	3.21	0.332	0.386	0.260	0	0	0	0.684	0.177	MEAN
ST.D.	3.63	0.681	10.9	3.57	0.324	0.529	1.24	0	0	0	1.14	0.267	ST.D.
MAX	18.4	2.78	60.6	13.9	1.91	2.23	6.90	0	0	0	5.51	0.983	MAX
MIN	0.259	0.0180	0	0.328	0.104	0	0	0	0	0	0	0	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 399
DRAINAGE AREA (hectares), 354.0

/charge/4100./data/loads/ho.flow90.o

TOTAL DAILY DISCHARGE FOR 1990 Kettle Creek Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.346	1.04	0.778	3.34	0.259	0.148	0.878	0.821	0.850	0.875	1.03	1.08	1
2	0.605	5.18	1.47	10.3	0.184	0.0684	0.349	0.353	0.749	0.612	0.922	0.889	2
3	1.05	3.20	4.32	7.99	0.162	0.922	0.101	0.137	0.605	0.468	0.857	9.32	3
4	3.89	2.16	1.38	4.70	0.356	0.724	0	0.0576	0.486	9.43	0.781	15.2	4
5	4.84	1.64	0.950	2.73	0.641	0.461	0	0.112	0.432	1.63	37.8	2.69	5
6	2.68	1.81	0.778	2.35	0.400	0.374	0	0.0216	3.72	0.958	16.0	1.48	6
7	2.07	4.23	0.605	1.71	0.328	0.263	0	0	10.7	0.796	2.28	1.47	7
8	2.16	34.6	0.518	1.32	0.234	2.63	0	0	2.55	0.986	1.58	3.25	8
9	3.54	56.6	9.42	1.15	0.133	1.27	23.5	0	1.38	25.4	1.88	5.78	9
10	6.04	13.6	12.5	13.2	0.112	0.738	1.85	0	1.04	20.6	2.92	6.98	10
11	6.66	5.10	27.2	12.5	0.0864	0.500	0.749	0.0036	0.781	36.4	1.81	3.42	11
12	4.15	3.28	30.0	3.93	0.0324	0.346	0.396	0.130	0.659	28.0	1.47	3.39	12
13	2.76	5.18	33.3	2.17	2.74	0.270	0.198	1.80	0.569	15.2	1.34	4.35	13
14	2.16	4.49	18.6	2.36	1.62	0.173	7.11	0.713	18.2	6.62	1.44	2.00	14
15	1.99	2.07	10.6	2.57	1.17	0.0792	4.64	0.346	11.7	3.96	1.62	1.87	15
16	2.33	1.81	12.1	1.77	19.2	0	1.33	0.205	3.29	2.48	1.37	5.39	16
17	31.8	1.73	8.29	2.32	35.8	0	0.706	0.133	1.74	1.91	0.886	4.35	17
18	68.0	1.56	4.41	1.46	11.6	0	0.436	0.0648	1.12	37.8	0.522	26.2	18
19	11.3	1.38	4.43	1.13	4.94	0	0.281	0.108	1.59	9.13	0.353	16.6	19
20	6.92	1.20	3.60	2.02	13.3	0	0.731	0.162	1.81	5.03	0.202	6.81	20
21	4.44	1.30	3.56	6.47	9.13	0	0.497	0.169	1.66	3.18	0.0828	14.5	21
22	2.59	126	6.27	2.51	3.93	0	0.331	0.0864	2.89	2.56	6.51	25.1	22
23	2.16	42.3	9.42	1.57	2.21	1.17	0.418	0.0504	1.92	2.06	2.00	15.2	23
24	9.50	8.38	3.24	1.13	1.39	3.43	0.320	0	2.90	1.66	1.01	8.99	24
25	19.6	2.25	2.42	0.907	1.07	1.41	0.324	0	1.70	1.44	0.760	5.01	25
26	11.7	1.64	2.02	0.770	0.893	0.788	0.140	0	1.35	1.23	0.511	2.76	26
27	5.44	1.21	1.68	0.659	0.684	0.760	0.0072	0.0540	0.857	1.18	5.86	1.21	27
28	6.83	0.950	1.59	0.540	0.500	0.443	0	87.7	0.691	1.22	8.64	1.04	28
29	3.02		1.51	0.432	0.587	0.335	0	23.7	0.572	1.18	2.84	86.4	29
30	1.90		3.39	0.349	0.457	0.587	6.46	3.20	1.01	1.17	1.43	51.8	30
31	1.21		3.26		0.331		3.05	1.33		1.08		9.07	31
TOTAL	233	335	223	96.4	114	17.9	54.7	121	79.6	226	106	343	TOTAL
MEAN	7.54	12.0	7.22	3.21	3.70	0.596	1.77	3.92	2.65	7.30	3.56	11.1	MEAN
ST.D.	12.9	26.2	8.80	3.46	7.50	0.780	4.42	16.1	3.95	10.8	7.21	17.5	ST.D.
MAX	68.0	126	33.3	13.2	35.8	3.43	23.5	87.7	18.2	37.8	37.8	86.4	MAX
MIN	0.346	0.950	0.518	0.349	0.0324	0	0	0	0.432	0.468	0.0828	0.889	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 1954
DRAINAGE AREA (hectares), 354.0

TOTAL DAILY DISCHARGE FOR 1991 Kettle Creek Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	5.88	0.346	2.59	2.65	1.24	0.562	0	0	0	0	0	0	1
2	4.15	0.259	34.6	2.43	1.11	0.311	0	0	0	0	0	0	2
3	3.02	1.04	13.0	2.33	0.847	0.225	0	0	0	0	0	0	3
4	1.99	2.76	5.18	2.09	0.700	0.0518	0	0	0	0	0	0	4
5	1.47	5.88	7.78	2.38	0.605	0.0173	0	0	0	0	0	0	5
6	1.04	5.01	49.2	2.47	0.864	0	0	0	0	0	0	0	6
7	0.778	4.15	13.0	2.47	0.492	0	0	0	0	0	0	0	7
8	0.691	3.20	4.58	2.19	0.346	0	0	0	0	0	0	1.81	8
9	0.605	2.68	2.76	3.32	0.691	0	0	0	0	0	0	11.4	9
10	0.518	2.16	2.25	3.37	0.544	0	0	0	0	0	0	3.40	10
11	0.518	1.81	1.99	2.58	0.320	0	0	0	0	0	0	1.60	11
12	0.432	1.47	1.81	2.19	0.242	0	0	0	0	0	0	0.933	12
13	0.432	1.30	1.64	2.00	0.138	0	0	0	0	0	0	2.73	13
14	0.432	1.12	1.47	2.12	0.0691	0	0	0	0	0	0	2.16	14
15	0.432	1.04	1.38	5.30	0.0518	0	0	0	0	0	0	0.950	15
16	1.73	0.950	1.30	3.17	0.0346	0	0	0	0	0	0	0.233	16
17	4.32	0.864	2.59	2.57	0.0346	0	0	0	0	0	0	0.0864	17
18	3.46	1.04	23.9	2.21	0.0432	0	0	0	0	0	0	0.0778	18
19	2.85	11.7	12.6	2.83	0.0259	0	0	0	0	0	0	0.0518	19
20	4.84	19.7	6.16	13.7	0.0173	0	0	0	0	0	0	0.0518	20
21	3.28	17.3	5.18	8.54	0	0	0	0	0	0	0	0.0605	21
22	2.33	14.7	4.09	5.65	0	0	0	0	0	0	0	0.0691	22
23	1.73	4.84	6.64	3.28	0	0	0	0	0	0	0	0.0691	23
24	1.21	3.02	7.95	3.01	0	0	0	0	0	0	0	0.0691	24
25	0.950	2.59	5.04	2.64	0	0	0	0	0	0	0	0.0518	25
26	0.864	2.42	3.83	2.10	1.45	0	0	0	0	0	0	0.0259	26
27	0.778	2.33	16.3	1.93	1.42	0	0	0	0	0	0	0.0259	27
28	0.691	2.25	11.7	1.79	0.734	0	0	0	0	0	0	0.0173	28
29	0.605		4.23	1.61	0.415	0	0	0	0	0	0	0.0518	29
30	0.518		3.08	1.40	0.786	0	0	0	0	0	0	0.0518	30
31	0.432		2.73		1.43		0	0		0		0.0518	31
TOTAL	53.0	117	260	96.3	14.7	1.17	0	0	0	0	0	26.0	TOTAL
MEAN	1.71	4.21	8.40	3.21	0.473	0.0389	0	0	0	0	0	0.840	MEAN
ST.D.	1.52	5.16	10.5	2.44	0.483	0.120	0	0	0	0	0	2.16	ST.D.
MAX	5.88	19.7	49.2	13.7	1.45	0.562	0	0	0	0	0	11.4	MAX
MIN	0.432	0.259	1.30	1.40	0	0	0	0	0	0	0	0	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 569
DRAINAGE AREA (hectares), 354.0

TOTAL DAILY DISCHARGE FOR 1992 Kettle Creek Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.0864	1.81	10.6	5.13	1.20	0	---	---	---	---	---	---	1
2	0.0864	1.56	9.47	2.80	1.19	0	---	---	---	---	---	---	2
3	0.0864	1.30	7.55	1.93	1.02	0	---	---	---	---	---	---	3
4	0.490	1.12	8.67	1.98	0.835	0	---	---	---	---	---	---	4
5	6.88	0.950	10.8	1.50	1.03	0	---	---	---	---	---	---	5
6	5.28	0.778	17.3	1.30	1.39	0	---	---	---	---	---	---	6
7	1.97	0.691	32.0	1.30	1.48	0	---	---	---	---	---	---	7
8	1.11	0.605	25.5	1.12	1.26	0	---	---	---	---	---	---	8
9	1.42	0.518	13.3	1.09	1.04	0	---	---	---	---	---	---	9
10	4.10	0.432	20.0	0.914	0.821	0	---	---	---	---	---	---	10
11	1.65	0.346	5.18	1.36	0.623	0	---	---	---	---	---	---	11
12	1.05	0.259	2.59	1.43	0.497	0	---	---	---	---	---	---	12
13	10.2	0.173	2.07	1.36	0.414	0	---	---	---	---	---	---	13
14	12.9	0.173	1.73	1.48	0.252	0	---	---	---	---	---	---	14
15	7.78	3.46	1.56	1.53	0.173	0	---	---	---	---	---	---	15
16	5.62	21.6	1.47	39.4	0.126	0	---	---	---	---	---	---	16
17	3.80	20.0	1.38	20.9	0.0900	0	---	---	---	---	---	---	17
18	2.59	13.7	1.30	10.7	0.0864	0	---	---	---	---	---	---	18
19	1.73	43.2	1.21	7.03	0.0864	0	---	---	---	---	---	---	19
20	1.21	32.2	1.12	3.81	0.0288	0	---	---	---	---	---	---	20
21	1.04	20.1	1.12	5.93	0	0	---	---	---	---	---	---	21
22	0.864	21.0	1.12	5.83	0	0	---	---	---	---	---	---	22
23	11.0	25.1	1.38	3.25	0	0	---	---	---	---	---	---	23
24	34.1	15.5	1.66	25.7	0	0	---	---	---	---	---	---	24
25	24.9	11.4	2.37	13.2	0	0	---	---	---	---	---	---	25
26	9.55	10.2	5.87	8.07	0	0	---	---	---	---	---	---	26
27	4.31	12.2	5.36	4.59	0	0	---	---	---	---	---	---	27
28	3.24	14.7	2.35	2.39	0	0	---	---	---	---	---	---	28
29	2.59	7.78	1.75	1.61	0	0	---	---	---	---	---	---	29
30	2.25		1.97	1.50	0	0	---	---	---	---	---	---	30
31	1.99		2.25		0		---	---		---		---	31
TOTAL	165	282	201	180	13.6	0	---	---	---	---	---	---	TOTAL
MEAN	5.35	9.76	6.51	6.00	0.440	0	---	---	---	---	---	---	MEAN
ST.D.	7.41	11.3	7.81	8.63	0.518	0	---	---	---	---	---	---	ST.D.
MAX	34.1	43.2	32.0	39.4	1.48	0	---	---	---	---	---	---	MAX
MIN	0.0864	0.173	1.12	0.914	0	0	---	---	---	---	---	---	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 844
DRAINAGE AREA (hectares), 354.0

SUB-WATERSHED DAILY DISCHARGE

PITTOCK TEST

TOTAL DAILY DISCHARGE FOR 1989 Pittock Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	2.03	7.51	0.0864	7.55	0.302	1.10	0.0864	0	0	0	0	0.428	1
2	1.74	3.84	0.0864	7.40	0.349	1.92	0.0864	0	0	0	0	0.432	2
3	1.32	2.55	0.0864	17.2	0.259	1.36	0.0864	0	0	0	0	0.173	3
4	1.04	2.00	0.112	21.7	0.227	0.904	0.0864	0	0	0	0	0.173	4
5	0.605	1.47	0.0936	16.0	0.403	0.565	0.0576	0	0	0	0	0.194	5
6	0.486	0.864	0.0864	14.0	0.378	0.353	0.0468	0	0	0	0	0.173	6
7	0.486	0.691	0.0864	9.87	0.320	0.227	0.0108	0	0	0	0.0360	0.0936	7
8	23.4	0.605	0.0864	6.53	0.346	0.173	0	0	0	0	0.119	0.0864	8
9	9.22	0.259	0.130	4.69	0.259	1.63	0	0	0	0	0.0864	0.0864	9
10	4.45	0.259	3.46	3.98	0.205	4.23	0	0	0	0	0.0468	0.0864	10
11	2.31	0.259	6.52	3.29	0.202	1.55	0	0	0	0	0	0.0864	11
12	5.42	0.173	2.59	4.38	0.479	1.20	0	0	0	0	0	0.0864	12
13	2.59	0.173	1.47	8.36	0.583	0.799	0	0	0	0	0	0.0864	13
14	1.67	0.778	3.19	7.27	0.464	0.389	0	0	0	0	0	0.0864	14
15	1.43	0.778	5.00	10.6	0.407	0.281	0	0.0072	0	0	3.02	0.0864	15
16	0.860	0.259	1.13	6.66	0.295	0.259	0	0	0	0	5.32	0.0864	16
17	0.796	0.173	0.540	5.11	0.248	0.353	0	0	0	0	1.64	0.0864	17
18	1.47	0.173	7.91	6.06	0.212	1.05	0	0	0	0	0.655	0.0756	18
19	2.02	0.173	4.60	3.97	0.176	0.490	0.0288	0	0	0	0.349	0.0720	19
20	1.04	0.173	2.57	2.79	0.220	0.500	0.101	0	0	0	1.34	0.0720	20
21	0.605	0.173	1.58	2.01	0.209	0.396	0.0108	0	0	0	1.19	0	21
22	0.778	0.155	1.03	1.42	0.169	4.53	0	0	0	0	0.522	0	22
23	0.864	0.0864	3.84	1.04	0.155	2.43	0	0	0	0	0.306	0	23
24	1.47	0.0864	8.08	0.774	0.155	1.63	0	0	0	0	0.187	0	24
25	1.12	0.0864	18.1	0.709	0.155	0.976	0	0	0	0	0.173	0.0259	25
26	7.34	0.166	13.6	0.608	0.698	0.630	0	0	0	0	0.173	0.0259	26
27	2.67	0.101	13.2	0.522	0.277	0.374	0.0648	0	0	0	0.151	0.0259	27
28	3.21	0.0864	24.5	0.486	0.173	0.234	0.0504	0	0	0	2.65	0.0259	28
29	4.05		28.2	0.443	0.140	0.133	0	0	0	0	1.43	0.0259	29
30	6.71		15.7	0.349	1.01	0.126	0	0	0	0	0.896	0.0259	30
31	5.88		11.7		1.24		0	0		0		0.0864	31
TOTAL	99.1	24.1	179	175	10.7	30.8	0.716	0.0072	0	0	20.3	2.99	TOTAL
MEAN	3.20	0.860	5.78	5.86	0.346	1.03	0.0231	0.0002	0	0	0.676	0.0965	MEAN
ST.D.	4.38	1.57	7.53	5.52	0.248	1.09	0.0350	0.0013	0	0	1.18	0.103	ST.D.
MAX	23.4	7.51	28.2	21.7	1.24	4.53	0.101	0.0072	0	0	5.32	0.432	MAX
MIN	0.486	0.0864	0.0864	0.349	0.140	0.126	0	0	0	0	0	0	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 543
DRAINAGE AREA (hectares), 359.0

TOTAL DAILY DISCHARGE FOR 1990 Pittock Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.288	6.73	1.69	3.46	0.173	0.173	0.0360	0.331	0.248	5.31	0.727	3.69	1
2	0.263	5.34	5.72	4.14	0.0900	0.173	0	0.140	0.194	2.97	0.716	2.48	2
3	0.259	2.47	3.96	4.64	0.0864	0.389	0	0.0972	0.112	2.30	0.608	3.38	3
4	2.68	2.01	1.90	3.99	0.126	0.227	0	0.0864	0.0864	8.75	0.644	9.22	4
5	9.76	1.57	1.12	2.45	0.234	0.173	0	0.0864	0.122	5.73	26.6	6.02	5
6	3.75	1.43	0.588	1.71	0.144	0.173	0	0.0576	0.119	3.06	38.7	4.70	6
7	2.15	1.61	0.501	1.30	0.126	0.112	0	0.0252	0.151	2.00	17.0	3.64	7
8	1.96	14.5	1.94	0.983	0.0864	0.140	2.10	0.0144	0.0864	2.96	10.8	3.27	8
9	1.42	29.5	10.4	0.907	0.0864	0.0864	14.5	0	0.0864	19.6	8.00	3.99	9
10	1.19	14.6	14.8	2.05	0.108	0.0864	2.02	0	0.0864	19.2	6.68	7.19	10
11	0.864	6.94	24.5	4.87	0.0720	0.0864	0.868	0	0.0864	17.4	5.34	6.53	11
12	0.674	3.95	25.9	2.85	0.0864	0.0864	0.464	0.0792	0.0864	11.7	4.01	5.30	12
13	0.605	3.98	26.8	1.80	0.504	0.0864	0.209	0.572	0.0828	11.9	3.46	9.32	13
14	0.553	2.73	19.2	1.92	0.360	0.0864	0.346	0.209	0.947	6.40	3.51	5.07	14
15	0.605	1.43	15.7	2.87	0.274	0.0720	0.396	0.0972	3.36	3.99	3.79	4.05	15
16	0.553	1.10	15.1	2.79	2.17	0.0396	0.223	0.0864	1.57	2.49	3.72	2.76	16
17	16.7	0.968	12.6	2.60	13.3	0.0612	0.169	0.0864	0.986	5.30	2.63	2.53	17
18	37.8	1.23	7.52	1.92	12.7	0.0576	0.140	0.0864	0.698	17.7	2.16	6.85	18
19	12.9	0.994	5.22	1.56	6.66	0.0180	0.112	5.40	0.727	10.7	1.94	8.01	19
20	6.58	0.691	4.64	1.45	9.42	0	0.281	2.28	0.493	5.39	1.44	5.49	20
21	3.76	0.810	4.78	2.31	9.69	0.0216	0.223	1.20	0.446	3.50	1.44	4.93	21
22	2.53	29.5	9.24	2.10	5.27	0.0432	0.245	0.842	0.515	2.60	8.45	11.1	22
23	1.76	35.9	13.6	1.40	3.26	0.194	0.400	0.475	0.432	2.14	8.74	15.0	23
24	7.12	15.2	5.09	1.07	1.97	0.151	0.241	0.292	0.432	1.59	6.81	9.46	24
25	12.0	7.04	3.14	0.803	1.43	0.0864	0.133	0.198	0.432	1.30	5.16	5.91	25
26	7.90	3.99	2.15	0.565	1.20	0.0864	0.0864	0.140	0.385	1.14	3.69	3.63	26
27	8.12	2.57	1.56	0.403	0.792	0.0864	0.0864	0.0972	0.259	1.07	6.76	2.67	27
28	9.06	1.57	1.13	0.385	0.583	0.0720	0.0864	1.30	4.49	1.13	12.5	2.41	28
29	4.00		1.05	0.256	0.410	0.0864	0.0756	1.57	7.43	0.806	8.50	32.9	29
30	2.34		2.19	0.202	0.281	0.0792	1.45	0.763	8.55	0.911	5.17	45.8	30
31	1.68		3.39		0.209		1.04	0.400		0.724		19.1	31
TOTAL	161	200	247	59.7	71.9	3.23	26.0	17.0	33.7	181	209	256	TOTAL
MEAN	5.22	7.15	7.97	1.99	2.32	0.108	0.837	0.549	1.12	5.86	6.99	8.27	MEAN
ST.D.	7.44	9.64	7.89	1.29	3.88	0.0764	2.60	1.05	2.11	5.84	8.12	9.25	ST.D.
MAX	37.8	35.9	26.8	4.87	13.3	0.389	14.5	5.40	8.55	19.6	38.7	45.8	MAX
MIN	0.259	0.691	0.501	0.202	0.0720	0	0	0	0.0828	0.724	0.608	2.41	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 1468
DRAINAGE AREA (hectares), 359.0

/charge/4100./data/loads/go.flow91.out

TOTAL DAILY DISCHARGE FOR 1991 Pittock Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	7.08	0.180	2.36	3.79	1.13	0.639	0	0	0	0	0	0.648	1
2	3.63	0.234	20.4	3.21	0.769	0.458	0	0	0	0	0	0.173	2
3	2.48	0.626	18.3	2.66	0.596	0.354	0	0	0	0	0	0.147	3
4	1.78	7.05	7.69	2.48	0.484	0.233	0	0.406	0	0	0	0.0432	4
5	1.50	13.1	7.19	2.47	0.484	0.181	0.0605	0.0346	0	0	0	0.0086	5
6	1.13	7.43	20.8	2.47	0.648	0.156	0	0	0	0	0	0.0173	6
7	0.829	6.44	17.9	2.37	0.415	0.138	0.156	0	0	0	0	0.501	7
8	0.648	7.37	6.88	4.33	0.337	0.130	0.130	0	0	0	0	3.45	8
9	0.484	6.11	4.63	15.4	0.492	0.112	0.0173	0	0	0	0	3.46	9
10	0.450	4.25	3.57	18.4	0.441	0.104	0	0	0	0	0	1.51	10
11	0.724	2.97	2.97	6.26	0.432	0.190	0	0	0	0	0	1.03	11
12	0.720	2.20	2.58	3.89	0.432	0.104	0	0	0	0	0	0.847	12
13	0.396	1.38	2.31	2.95	0.389	0.0778	0.0518	0	0	0	0	1.09	13
14	0.418	1.21	2.16	2.54	0.328	0.0691	0	0	0	0	0	0.950	14
15	0.364	0.734	2.35	13.9	0.268	0.0950	0	0	0	0	0	0.734	15
16	1.37	0.484	2.62	12.8	0.225	0.121	0	0	0	0	0	0.492	16
17	2.04	0.380	2.73	5.24	0.432	0.0605	0	0	0	0	0	0.510	17
18	1.60	0.311	13.1	3.75	0.207	0.0518	0	0	0	0	0	0.328	18
19	1.47	14.7	11.6	2.83	0.181	0.0518	0	0	0	0	0	0.302	19
20	1.38	13.4	7.26	6.15	0.181	0.0346	0	0	0	0	0.130	0.285	20
21	1.21	10.6	7.37	13.4	0.190	0.0259	0	0	0	0	0.104	0.302	21
22	0.864	12.4	5.71	9.42	0.173	0.0259	0	0	0	0	0	0.259	22
23	0.950	5.34	7.72	4.95	0.147	0.0173	0	0	0	0	0	0.276	23
24	0.467	3.63	12.6	3.35	0.251	0.0086	0	0	0	0	0	0.181	24
25	0.380	2.61	7.86	2.53	0.994	0.0086	0	0	0	0	0	0.138	25
26	0.363	2.26	5.36	2.18	4.63	0.0086	0	0	0	0	0	0.0864	26
27	0.346	1.84	79.6	1.92	2.98	0.0086	0	0	0	0	0	0.0778	27
28	0.242	1.44	44.0	1.58	1.95	0.0086	0	0	0	0	0	0.0950	28
29	0.207		15.1	1.30	1.57	0	0	0	0	0	0.0432	0.190	29
30	0.199		7.02	1.16	1.31	0	0.0950	0	0	0	1.96	0.225	30
31	0.190		4.79		1.01		0	0		0		0.242	31
TOTAL	35.9	130	356	159	24.1	3.47	0.510	0.441	0	0	2.24	18.6	TOTAL
MEAN	1.16	4.67	11.5	5.32	0.777	0.116	0.0164	0.0142	0	0	0.0746	0.600	MEAN
ST.D.	1.34	4.54	15.3	4.69	0.943	0.145	0.0401	0.0730	0	0	0.358	0.843	ST.D.
MAX	7.08	14.7	79.6	18.4	4.63	0.639	0.156	0.406	0	0	1.96	3.46	MAX
MIN	0.190	0.180	2.16	1.16	0.147	0	0	0	0	0	0	0.0086	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 732
DRAINAGE AREA (hectares), 359.0

/charge/4100./data/loads/go.flow92.out Mon Nov 2 15:49:01 1992

TOTAL DAILY DISCHARGE FOR 1992 Pittock Test

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.173	0.976	4.33	1.88	2.22	0.288	0.0173	---	---	---	---	---	1
2	0.173	0.795	4.53	1.78	13.0	0.259	0.0086	---	---	---	---	---	2
3	0.187	0.683	4.78	1.53	13.4	0.220	0.216	---	---	---	---	---	3
4	1.14	0.570	9.55	1.40	5.34	0.209	0.0950	---	---	---	---	---	4
5	2.90	0.510	18.1	0.983	3.14	0.288	0.0259	---	---	---	---	---	5
6	2.52	0.449	25.1	1.02	2.32	0.220	0	---	---	---	---	---	6
7	1.85	0.397	37.6	1.26	1.86	0.173	0	---	---	---	---	---	7
8	1.47	0.346	35.6	1.12	1.59	0.140	19.4	---	---	---	---	---	8
9	1.58	0.285	33.3	1.19	1.38	0.0864	12.1	---	---	---	---	---	9
10	2.30	0.259	33.4	0.972	0.940	0.104	3.28	---	---	---	---	---	10
11	1.89	0.251	13.3	4.11	0.785	0.0778	---	---	---	---	---	---	11
12	1.57	0.242	5.50	5.26	0.677	0.0605	---	---	---	---	---	---	12
13	2.54	0.233	3.18	3.23	0.526	0.0691	---	---	---	---	---	---	13
14	7.39	0.225	2.62	2.79	0.414	0.0518	---	---	---	---	---	---	14
15	4.32	0.864	1.91	2.42	0.306	0.0346	---	---	---	---	---	---	15
16	2.70	4.29	1.47	38.6	0.241	0.0259	---	---	---	---	---	---	16
17	1.99	2.67	1.81	44.3	3.27	0.0346	---	---	---	---	---	---	17
18	1.48	2.60	1.71	18.5	3.19	0.190	---	---	---	---	---	---	18
19	1.44	21.7	1.64	10.5	1.90	0.181	---	---	---	---	---	---	19
20	1.26	16.2	1.31	6.33	1.48	0.0864	---	---	---	---	---	---	20
21	0.972	8.59	1.05	5.62	1.04	0.0864	---	---	---	---	---	---	21
22	0.698	6.61	1.10	7.55	0.760	0.0605	---	---	---	---	---	---	22
23	16.4	6.85	0.742	4.55	0.641	0.0605	---	---	---	---	---	---	23
24	8.21	7.18	0.526	5.48	0.367	0.121	---	---	---	---	---	---	24
25	3.51	5.05	0.810	10.5	0.310	0.0778	---	---	---	---	---	---	25
26	2.48	4.59	1.58	7.79	0.302	0.0691	---	---	---	---	---	---	26
27	2.08	4.04	1.76	4.70	0.227	0.0518	---	---	---	---	---	---	27
28	1.61	4.44	1.49	3.20	0.173	0.0259	---	---	---	---	---	---	28
29	1.51	3.43	1.34	2.61	0.173	0.0259	---	---	---	---	---	---	29
30	1.50		1.56	2.37	0.194	0.0259	---	---	---	---	---	---	30
31	1.35		1.70		0.331		---	---	---	---	---	---	31
TOTAL	81.2	105	254	203	62.5	3.40	35.2#	---	---	---	---	---	TOTAL
MEAN	2.62	3.63	8.21	6.78	2.02	0.113	3.52	---	---	---	---	---	MEAN
ST.D.	3.11	4.99	11.8	10.2	3.22	0.0823	6.76	---	---	---	---	---	ST.D.
MAX	16.4	21.7	37.6	44.3	13.4	0.288	19.4	---	---	---	---	---	MAX
MIN	0.173	0.225	0.526	0.972	0.173	0.0259	0	---	---	---	---	---	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 745
DRAINAGE AREA (hectares), 359.0

SUB-WATERSHED DAILY DISCHARGE

PITTOCK CONTROL

TOTAL DAILY DISCHARGE FOR 1989 Pittock Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.929	3.19	0.245	3.15	0.756	0.810	0.259	0.173	0.0864	0	0	0	1
2	0.770	1.59	0.209	2.68	0.778	1.26	0.259	0.173	0.0864	0	0	0	2
3	0.515	1.13	0.234	6.06	0.778	1.05	0.259	0.173	0.0864	0	0	0	3
4	0.230	0.896	0.259	10.2	0.716	0.817	0.259	0.173	0.0864	0	0	0	4
5	0.259	0.778	0.209	6.42	0.756	0.652	0.288	0.173	0.0864	0	0	0	5
6	0.245	0.608	0.173	6.57	0.749	0.526	0.346	0.173	0.0864	0	0	0	6
7	0.238	0.443	0.191	4.31	0.760	0.486	0.288	0.115	0.0864	0	0.0108	0	7
8	18.1	0.472	0.220	3.39	0.698	0.432	0.346	0.0864	0.0864	0	0	0	8
9	3.33	0.360	0.310	2.32	0.702	0.619	0.328	0.0864	0.0864	0	0	0	9
10	1.49	0.346	1.70	1.56	0.648	0.727	0.259	0.0864	0.0864	0.0216	0	0	10
11	0.799	0.382	8.49	1.40	0.641	0.464	0.328	0.0864	0.0864	0	0	0	11
12	3.92	0.403	4.51	1.74	0.684	0.432	0.281	0.0864	0.0864	0	0	0	12
13	1.28	0.407	1.79	2.88	0.774	0.436	0.259	0.0864	0.0864	0	0	0	13
14	0.853	2.16	3.96	3.08	0.817	0.425	0.259	0.0864	0.0864	0	0	0	14
15	0.533	0.961	5.59	4.06	0.742	0.432	0.259	0.122	0.0864	0	1.15	0	15
16	0.421	0.446	1.58	2.76	0.666	0.400	0.259	0.119	0.0864	0	1.12	0	16
17	0.389	0.338	1.04	2.03	0.619	0.414	0.212	0.0864	0.0864	0	0.122	0	17
18	0.619	0.277	10.6	2.33	0.605	0.428	0.173	0.0864	0.0864	0	0.0576	0	18
19	0.637	0.317	6.61	1.75	0.551	0.374	0.223	0.0864	0.0864	0	0	0	19
20	0.371	0.306	2.69	1.43	0.554	0.392	0.216	0.0864	0.0864	0	0.101	0	20
21	0.259	0.346	1.66	1.24	0.529	0.374	0.173	0.0864	0	0	0.0792	0	21
22	0.295	0.274	1.41	1.13	0.518	2.31	0.173	0.0864	0.0504	0	0	0	22
23	0.781	0.259	5.88	1.05	0.518	0.893	0.173	0.0864	0.0252	0	0	0	23
24	1.05	0.209	7.41	1.04	0.490	0.659	0.173	0.0864	0.0180	0	0	0	24
25	0.662	0.259	9.41	1.05	0.475	0.526	0.173	0.0864	0.0036	0	0	0	25
26	9.90	0.302	4.63	0.972	0.544	0.425	0.173	0.0864	0	0	0	0	26
27	1.67	0.248	4.27	0.954	0.504	0.346	0.176	0.0864	0	0	0.0036	0	27
28	3.11	0.259	7.43	0.904	0.425	0.324	0.173	0.0864	0	0	0.443	0	28
29	4.28		11.8	0.868	0.403	0.259	0.173	0.0864	0	0	0.0936	0	29
30	6.65		5.68	0.821	0.698	0.259	0.173	0.0864	0	0	0.0576	0	30
31	3.41		3.86		0.925		0.173	0.0864		0		0.0864	31
TOTAL	68.0	18.0	113	80.2	20.0	17.9	7.26	3.29	1.83	0.0216	3.24	0.0864	TOTAL
MEAN	2.19	0.642	3.68	2.67	0.646	0.598	0.234	0.106	0.0608	0.0007	0.108	0.0028	MEAN
ST.D.	3.66	0.670	3.45	2.18	0.128	0.398	0.0582	0.0345	0.0380	0.0039	0.292	0.0155	ST.D.
MAX	18.1	3.19	11.8	10.2	0.925	2.31	0.346	0.173	0.0864	0.0216	1.15	0.0864	MAX
MIN	0.230	0.209	0.173	0.821	0.403	0.259	0.173	0.0864	0	0	0	0	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 333
DRAINAGE AREA (hectares), 384.0

TOTAL DAILY DISCHARGE FOR 1990 Pittock Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	3.31	4.54	1.23	2.59	0.918	0.691	0.432	0.346	0.259	0.259	0.479	2.06	1
2	1.48	2.55	3.09	3.15	0.842	0.698	0.432	0.328	0.202	0.227	0.486	1.46	2
3	0.932	1.26	2.12	3.34	0.828	0.778	0.432	0.324	0.173	0.184	0.436	2.15	3
4	5.42	0.847	1.25	3.10	0.817	0 731	0.428	0.324	0.173	1.49	0.432	4.41	4
5	3.50	0.596	0.979	2.08	0.882	0.644	0.432	0.320	0.198	1.13	9.99	2.87	5
6	1.41	0.553	0.742	1.50	0.814	0.659	0.367	0.263	0.238	0.670	19.1	2.38	6
7	0.565	0.583	0.644	1.30	0.799	0.601	0.346	0.259	0.209	0.385	8.64	1.88	7
8	0.234	9.75	1.15	1.21	0.720	0.612	2.15	0.259	0.184	0.472	4.36	1.70	8
9	0.158	21.4	6.78	1.14	0.662	0.598	8.14	0.259	0.173	5.04	3.26	2.03	9
10	0.173	9.82	14.7	1.74	0.691	0.518	1.31	0.259	0.173	5.44	3.03	3.13	10
11	0.0778	3.93	25.4	3.86	0.598	0.500	0.760	0.259	0.173	5.77	2.55	2.97	11
12	0.0605	2.25	23.9	2.53	0.594	0.522	0.515	0.266	0.173	4.19	1.75	3.25	12
13	0.0864	2.71	21.8	1.79	0.947	0.522	0.432	0.288	0.173	4.72	1.55	5.66	13
14	0.0864	1.92	17.7	1.90	1.00	0.518	0.454	0.259	0.320	2.41	1.57	2.94	14
15	0.0864	1.54	13.2	2.53	0.983	0.522	0.490	0.259	0.583	1.45	1.71	2.58	15
16	0.0864	1.30	10.9	2.71	1.78	0.518	0.432	0.259	0.328	1.06	1.62	1.70	16
17	19.5	0.875	8.41	2.38	8.25	0.518	0.432	0.259	0.259	1.26	1.26	1.70	17
18	23.8	0.900	5.12	1.90	7.80	0.497	0.785	0.259	0.220	7.97	1.21	3.89	18
19	5.82	0.792	3.50	1.58	4.03	0.468	0.734	0.382	0.259	4.51	1.15	3.91	19
20	2.66	0.515	2.95	1.61	4.17	0.443	0.878	0.295	0.259	2.71	1.00	2.85	20
21	1.58	0.569	3.07	2.41	5.53	0.432	0.738	0.259	0.227	1.84	0.958	3.03	21
22	1.12	23.0	4.98	2.08	3.24	0.432	0.580	0.259	0.259	1.41	2.95	7.82	22
23	0.760	29.1	8.97	1.71	2.03	0.490	0.676	0.259	0.259	1.25	3.37	9.27	23
24	4.14	15.8	4.00	1.41	1.51	0.454	0.522	0.259	0.259	1.11	2.89	5.84	24
25	6.52	6.39	2.68	1.35	1.39	0.432	0.382	0.259	0.259	0.925	2.29	3.47	25
26	3.65	3.18	1.96	1.24	1.28	0.432	0.371	0.259	0.216	0.824	1.72	2.06	26
27	4.36	2.07	1.47	1.14	1.13	0.432	0.346	0.266	0.173	0.781	3.19	1.67	27
28	4.81	1.33	1.33	1.12	0.994	0.432	0.346	0.284	0.173	0.752	5.76	1.57	28
29	2.16		1.26	1.04	0.914	0.432	0.346	0.284	0.173	0.562	3.95	29.1	29
30	1.30		1.63	0.965	0.817	0.432	0.410	0.259	0.216	0.526	2.58	36.0	30
31	0.842		2.24		0.720		0.364	0.256		0.518		22.7	31
TOTAL	100	150	199	58.4	57.7	16.0	25.5	8.63	6.94	61.8	95.2	178	TOTAL
MEAN	3.25	5.36	6.42	1.95	1.86	0.532	0.821	0.278	0.231	2.00	3.17	5.75	MEAN
ST.D.	5.30	7.69	7.24	0.764	2.03	0.102	1.40	0.0323	0.0803	2.02	3.73	8.22	ST.D.
MAX	23.8	29.1	25.4	3.86	8.25	0.778	8.14	0.382	0.583	7.97	19.1	36.0	MAX
MIN	0.0605	0.515	0.644	0.965	0.594	0.432	0.346	0.256	0.173	0.184	0.432	1.46	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 958
DRAINAGE AREA (hectares), 384.0

TOTAL DAILY DISCHARGE FOR 1991 Pittock Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	14.8	0.950	4.27	7.77	1.55	0.994	0.397	0.233	0.121	0.0605	0.0259	0.0346	1
2	5.96	0.950	27.0	5.18	1.43	0.968	0.415	0.225	0.130	0.0605	0.0259	0.0259	2
3	3.74	1.29	16.4	3.77	1.37	0.907	0.397	0.251	0.121	0.0605	0.0259	0.0346	3
4	2.55	5.34	8.06	3.27	1.24	0.847	0.397	0.285	0.121	0.0691	0.0259	0.0259	4
5	2.15	9.43	8.17	3.13	1.18	0.821	0.397	0.259	0.121	0.0605	0.0259	0.0259	5
6	1.86	5.61	21.7	2.91	1.24	0.786	0.372	0.233	0.104	0.0605	0.0259	0.0259	6
7	1.47	5.23	18.2	2.88	1.16	0.743	0.389	0.242	0.104	0.0605	0.0259	0.0259	7
8	1.42	5.66	7.98	2.98	1.13	0.700	0.397	0.242	0.104	0.0605	0.0259	0.104	8
9	1.44	4.79	5.18	14.2	1.14	0.648	0.363	0.242	0.104	0.0518	0.0173	0.268	9
10	1.26	3.79	3.38	19.1	1.09	0.613	0.346	0.233	0.112	0.0518	0.0259	0.0778	10
11	1.38	2.72	2.88	8.16	1.09	0.631	0.328	0.216	0.104	0.0518	0.0173	0.0432	11
12	1.38	2.16	2.48	4.55	1.07	0.648	0.328	0.216	0.0950	0.0518	0.0173	0.0346	12
13	1.30	1.98	2.13	3.53	1.06	0.570	0.346	0.199	0.0950	0.0518	0.0259	0.0346	13
14	1.29	1.96	2.12	3.30	1.06	0.579	0.320	0.207	0.0950	0.0432	0.0259	0.0346	14
15	1.12	1.37	1.95	14.3	1.08	0.588	0.302	0.190	0.0864	0.0518	0.0259	0.0346	15
16	1.60	1.15	2.08	13.7	0.968	0.613	0.294	0.199	0.0864	0.0432	0.0259	0.0259	16
17	1.78	1.13	2.11	7.14	1.00	0.553	0.276	0.207	0.0950	0.0432	0.0259	0.0259	17
18	1.50	1.05	11.2	4.35	0.907	0.510	0.294	0.199	0.0864	0.0432	0.0259	0.0259	18
19	1.40	11.4	10.3	3.19	0.890	0.501	0.302	0.199	0.0950	0.0432	0.0259	0.0259	19
20	1.41	10.2	7.48	7.57	0.847	0.467	0.302	0.190	0.0864	0.0432	0.0518	0.0259	20
21	1.35	9.98	7.94	14.5	0.890	0.458	0.311	0.181	0.0778	0.0346	0.0259	0.0259	21
22	1.21	9.23	6.89	12.3	0.881	0.432	0.294	0.181	0.0778	0.0346	0.0259	0.0259	22
23	1.31	4.28	8.70	6.67	0.864	0.449	0.276	0.173	0.0864	0.0432	0.0259	0.0259	23
24	1.13	2.98	12.6	3.67	1.16	0.432	0.268	0.164	0.0778	0.0432	0.0259	0.0259	24
25	1.09	2.13	9.40	2.76	1.55	0.458	0.268	0.164	0.0691	0.0518	0.0259	0.0173	25
26	1.13	1.90	6.88	2.34	4.31	0.415	0.259	0.164	0.0691	0.0518	0.0259	0.0173	26
27	1.11	1.65	77.9	2.09	2.28	0.415	0.259	0.147	0.0691	0.0518	0.0259	0.0259	27
28	1.05	1.48	47.1	1.88	1.48	0.415	0.251	0.147	0.0691	0.0346	0.0259	0.0259	28
29	0.950		28.4	1.64	1.31	0.406	0.259	0.147	0.0605	0.0259	0.0259	0.0173	29
30	0.943		23.0	1.59	1.55	0.397	0.449	0.138	0.0691	0.0259	0.0432	0.0173	30
31	0.950		18.2		1.32		0.251	0.130		0.0259		0.0173	31
TOTAL	63.0	111	412	184	40.1	18.0	10.1	6.20	2.79	1.49	0.795	1.20	TOTAL
MEAN	2.03	3.99	13.3	6.15	1.29	0.599	0.326	0.200	0.0930	0.0479	0.0265	0.0387	MEAN
ST.D.	2.56	3.26	15.6	4.79	0.631	0.177	0.0572	0.0391	0.0188	0.0113	0.0064	0.0459	ST.D.
MAX	14.8	11.4	77.9	19.1	4.31	0.994	0.449	0.285	0.130	0.0691	0.0518	0.268	MAX
MIN	0.943	0.950	1.95	1.59	0.847	0.397	0.251	0.130	0.0605	0.0259	0.0173	0.0173	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 852
DRAINAGE AREA (hectares), 384.0

/charge/4100./data/loads/we.flow92.out Mon Nov 2 15:49:44 1992

TOTAL DAILY DISCHARGE FOR 1992 Pittock Control

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0.0864	1.19	0.727	1.31	0.605	0.328	---	---	---	---	---	1
2	0	0.0864	1.25	0.724	6.62	0.644	0.311	---	---	---	---	---	2
3	0	0.0864	1.61	0.612	6.69	0.605	1.58	---	---	---	---	---	3
4	0	0.0864	4.00	0.590	3.06	0.594	0.579	---	---	---	---	---	4
5	0.0864	0.0864	7.92	0.511	1.97	0.551	0.354	---	---	---	---	---	5
6	0.0864	0.0864	14.9	0.518	1.36	0.594	0.320	---	---	---	---	---	6
7	0.0468	0.0864	24.3	0.558	1.21	0.569	0.302	---	---	---	---	---	7
8	0	0.0864	20.0	0.526	1.11	0.601	10.4	---	---	---	---	---	8
9	0.0432	0.0432	20.5	0.518	1.09	0.518	6.51	---	---	---	---	---	9
10	0.0864	0.0684	22.2	0.457	1.03	0.492	1.64	---	---	---	---	---	10
11	0.0864	0.0684	10.4	1.05	0.878	0.510	---	---	---	---	---	---	11
12	0.0864	0.0144	3.17	1.34	0.882	0.475	---	---	---	---	---	---	12
13	0.130	0	1.57	0.925	0.914	0.458	---	---	---	---	---	---	13
14	0.432	0	0.947	0.850	0.824	0.458	---	---	---	---	---	---	14
15	0.242	0.194	0.677	0.713	0.778	0.423	---	---	---	---	---	---	15
16	0.173	0.622	0.612	14.2	0.778	0.441	---	---	---	---	---	---	16
17	0.112	0.284	0.929	23.1	6.62	0.415	---	---	---	---	---	---	17
18	0.104	0.313	0.706	10.9	4.23	0.458	---	---	---	---	---	---	18
19	0.0950	7.02	0.702	5.97	1.78	0.449	---	---	---	---	---	---	19
20	0.0864	4.84	0.680	3.59	1.32	0.415	---	---	---	---	---	---	20
21	0.0691	2.05	0.536	2.94	1.02	0.406	---	---	---	---	---	---	21
22	0.0432	1.54	0.518	2.99	0.950	0.389	---	---	---	---	---	---	22
23	1.04	1.84	0.457	2.23	0.925	0.389	---	---	---	---	---	---	23
24	1.21	2.14	0.418	2.93	0.850	0.397	---	---	---	---	---	---	24
25	0.425	1.65	0.612	6.11	0.778	0.372	---	---	---	---	---	---	25
26	0.284	1.58	0.889	5.27	0.778	0.389	---	---	---	---	---	---	26
27	0.256	1.25	0.911	2.96	0.752	0.380	---	---	---	---	---	---	27
28	0.173	1.12	0.738	1.99	0.691	0.363	---	---	---	---	---	---	28
29	0.166	0.803	0.666	1.69	0.691	0.337	---	---	---	---	---	---	29
30	0.173		0.691	1.44	0.691	0.337	---	---	---	---	---	---	30
31	0.144		0.727		0.655		---	---		---		---	31
TOTAL	5.87	28.1	145	98.9	53.2	14.0	22.3#	---	---	---	---	---	TOTAL
MEAN	0.189	0.970	4.69	3.30	1.72	0.468	2.23	---	---	---	---	---	MEAN
ST.D.	0.273	1.57	7.43	4.91	1.80	0.0908	3.44	---	---	---	---	---	ST.D.
MAX	1.21	7.02	24.3	23.1	6.69	0.644	10.4	---	---	---	---	---	MAX
MIN	0	0	0.418	0.457	0.655	0.337	0.302	---	---	---	---	---	MIN

NOTE: discharge given in dam^3/d , # incomplete total.

TOTAL DISCHARGE FOR YEAR, 367
DRAINAGE AREA (hectares), 384.0

APPENDIX B

MICROBASIN SCALE HYDROLOGIC DATA

ESSEX MICROBASIN TOTAL DAILY RUNOFF

/charge/4100./data/loadsmicro/etb1.flow89.out Wed Dec 9 11:13:21 1992

TOTAL DAILY DISCHARGE FOR 1989 Essex Test Microbasin 1 (ETB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	9.00	---	---	---	---	---	---	1
2	---	---	---	---	---	6.12	---	---	---	---	---	---	2
3	---	---	---	---	---	0	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	0	---	---	---	22
23	---	---	---	---	---	---	---	---	0	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	0	---	---	---	---	---	---	---	30
31	---		---		59.8		---	---		---		---	31
TOTAL	---	---	---	---	59.8#	15.1#	---	---	0 #	---	---	---	TOTAL
MEAN	---	---	---	---	29.9	5.04	---	---	0	---	---	---	MEAN
ST.D.	---	---	---	---	42.3	4.60	---	---	0	---	---	---	ST.D.
MAX	---	---	---	---	59.8	9.00	---	---	0	---	---	---	MAX
MIN	---	---	---	---	0	0	---	---	0	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	1.13	0.170	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 74.9
DRAINAGE AREA (hectares), 5.3

TOTAL DAILY DISCHARGE FOR 1990 Essex Test Microbasin 1 (ETB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	0	---	---	---	---	---	---	---	3
4	---	---	---	0	0	---	---	---	---	0	---	---	4
5	---	---	---	0	0	---	---	---	---	0	---	---	5
6	---	---	---	0	0	---	---	---	---	0	---	---	6
7	---	---	---	---	0	---	---	---	0.720	0	---	---	7
8	---	---	---	---	0	---	---	---	0	0	---	---	8
9	---	---	---	0	0	---	---	---	---	188	---	---	9
10	---	---	---	109	0	---	---	---	---	277	---	---	10
11	---	---	---	2.52	0	---	---	---	---	15.1	---	---	11
12	---	---	---	0	0	---	---	---	---	1.80	---	---	12
13	---	---	---	0	16.9	---	---	---	---	0	---	---	13
14	---	---	---	9.00	1.44	---	---	---	376	0	---	---	14
15	---	---	0	0	0	28.4	---	---	81.4	0	---	---	15
16	---	---	1.44	0	127	4.32	---	---	3.96	---	---	---	16
17	---	---	0	---	20.2	59.0	---	---	18.4	---	---	---	17
18	---	---	0	0	0	2.16	---	---	0	---	---	---	18
19	---	---	0	0	---	0	---	---	96.1	---	---	---	19
20	---	---	0	10.8	---	---	---	---	0	---	---	---	20
21	---	---	0	5.76	---	---	---	---	---	---	---	---	21
22	---	---	0	0	---	---	---	---	---	---	---	---	22
23	---	---	---	0	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	0	---	---	---	---	---	---	---	---	25
26	---	---	---	0	---	---	---	---	---	---	---	---	26
27	---	---	---	0	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	1.44#	137#	165#	94.0#	---	---	576#	482#	---	---	TOTAL
MEAN	---	---	0.180	6.89	10.4	18.8	---	---	64.1	40.2	---	---	MEAN
ST.D.	---	---	0.509	24.4	31.8	25.3	---	---	122	92.0	---	---	ST.D.
MAX	---	---	1.44	109	127	59.0	---	---	376	277	---	---	MAX
MIN	---	---	0	0	0	0	---	---	0	0	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	0.0272	2.07	2.40	1.11	---	---	7.10	5.23	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 1458
DRAINAGE AREA (hectares), 5.3

/charge/4100./data/loadsmicro/etb2.flow89.out Wed Dec 9 11:13:32 1992

TOTAL DAILY DISCHARGE FOR 1989 Essex Test Microbasin 2 (ETB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	6.84	---	---	---	---	---	---	1
2	---	---	---	---	---	58.3	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	2.16	---	---	---	---	---	---	---	30
31	---		---		140		---	---		---		---	31
TOTAL	---	---	---	---	142#	65.2#	---	---	---	---	---	---	TOTAL
MEAN	---	---	---	---	71.1	32.6	---	---	---	---	---	---	MEAN
ST.D.	---	---	---	---	97.5	36.4	---	---	---	---	---	---	ST.D.
MAX	---	---	---	---	140	58.3	---	---	---	---	---	---	MAX
MIN	---	---	---	---	2.16	6.84	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	2.30	0.956	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 207
DRAINAGE AREA (hectares), 6.1

TOTAL DAILY DISCHARGE FOR 1990 Essex Test Microbasin 2 (ETB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	2.16	---	---	---	---	---	---	2
3	---	---	---	---	0	---	---	---	---	---	---	---	3
4	---	---	---	---	0	---	---	---	---	---	---	---	4
5	---	---	---	---	0	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	855	---	---	---	7
8	---	---	---	---	---	---	---	---	32.0	---	---	---	8
9	---	---	---	0	---	---	---	---	---	---	---	---	9
10	---	---	---	3.24	---	---	---	---	---	---	---	---	10
11	---	---	---	5.40	0	---	---	---	---	---	---	---	11
12	---	---	---	0	0	---	---	---	---	---	---	---	12
13	---	---	---	---	0.360	---	---	---	---	---	---	---	13
14	---	---	---	---	0	---	---	---	---	---	---	---	14
15	---	---	---	---	0	---	---	---	---	---	---	---	15
16	---	---	---	---	66.2	---	---	---	---	---	---	---	16
17	---	---	---	---	16.2	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	0	---	---	---	18
19	---	---	---	---	---	---	---	---	565	---	---	---	19
20	---	---	---	---	---	---	---	---	20.5	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	---	---	---	---	---	---	---	---	30
31	---		---		32.4		---	---		---		---	31
TOTAL	---	---	---	8.64#	115#	2.16#	---	---	1473#	---	---	---	TOTAL
MEAN	---	---	---	2.16	10.5	2.16	---	---	294	---	---	---	MEAN
ST.D.	---	---	---	2.65	21.2	---	---	---	393	---	---	---	ST.D.
MAX	---	---	---	5.40	66.2	2.16	---	---	855	---	---	---	MAX
MIN	---	---	---	0	0	2.16	---	---	0	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	0.0885	1.09	0.0354	---	---	14.0	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 1599
DRAINAGE AREA (hectares), 6.1

TOTAL DAILY DISCHARGE FOR 1989 Essex Control Microbasin 1 (ECB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	13.3	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	8.64	---	---	---	---	---	---	---	30
31	---		---		117		---	---		---		---	31
TOTAL	---	---	---	---	125#	13.3#	---	---	---	---	---	---	TOTAL
MEAN	---	---	---	---	62.8	13.3	---	---	---	---	---	---	MEAN
ST.D.	---	---	---	---	76.6	---	---	---	---	---	---	---	ST.D.
MAX	---	---	---	---	117	13.3	---	---	---	---	---	---	MAX
MIN	---	---	---	---	8.64	13.3	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	1.43	0.162	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 138
DRAINAGE AREA (hectares), 8.2

/charge/4100./data/loadsmicro/ecb1.flow90.out Wed Dec 9 11:26:53 1992

TOTAL DAILY DISCHARGE FOR 1990 Essex Control Microbasin 1 (ECB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	0	---	---	---	---	---	---	---	---	4
5	---	---	---	0	---	---	---	---	---	---	---	---	5
6	---	---	---	10.4	---	---	---	---	---	---	---	---	6
7	---	---	---	0.720	---	---	---	---	44.6	---	---	---	7
8	---	---	---	4.68	---	---	---	---	0	---	---	---	8
9	---	---	---	0	---	---	---	---	---	---	---	---	9
10	---	---	---	23.8	---	---	---	---	---	---	---	---	10
11	---	---	---	3.96	---	---	---	---	---	---	---	---	11
12	---	---	---	0	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	0	---	---	---	18
19	---	---	---	---	---	---	---	---	83.2	---	---	---	19
20	---	---	---	---	---	---	---	---	0	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	---	43.6#	---	---	---	---	127#	---	---	---	TOTAL
MEAN	---	---	---	4.84	---	---	---	---	25.6	---	---	---	MEAN
ST.D.	---	---	---	7.91	---	---	---	---	37.6	---	---	---	ST.D.
MAX	---	---	---	23.8	---	---	---	---	83.2	---	---	---	MAX
MIN	---	---	---	0	---	---	---	---	0	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	0.290	---	---	---	---	1.01	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 171
DRAINAGE AREA (hectares), 8.2

TOTAL DAILY DISCHARGE FOR 1989 Essex Control Microbasin 2 (ECB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	10.4	---	---	---	---	---	---	1
2	---	---	---	---	---	59.8	---	---	---	---	---	---	2
3	---	---	---	---	---	0	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	0	---	---	---	22
23	---	---	---	---	---	---	---	---	0	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	0	---	---	---	---	---	---	---	30
31	---		---		373		---	---		---		---	31
TOTAL	---	---	---	---	373#	70.2#	---	---	0 #	---	---	---	TOTAL
MEAN	---	---	---	---	186	23.4	---	---	0	---	---	---	MEAN
ST.D.	---	---	---	---	263	31.9	---	---	0	---	---	---	ST.D.
MAX	---	---	---	---	373	59.8	---	---	0	---	---	---	MAX
MIN	---	---	---	---	0	0	---	---	0	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	2.71	0.433	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 443
DRAINAGE AREA (hectares), 13.8

/charge/4100./data/loadsmicro/ecb2.flow90.out Wed Dec 9 11:27:00 1992

TOTAL DAILY DISCHARGE FOR 1990 Essex Control Microbasin 2 (ECB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	137	---	---	---	---	---	---	1
2	---	---	---	---	---	88.9	---	---	---	0	---	---	2
3	---	---	---	---	---	---	---	---	---	0	---	---	3
4	---	---	---	3.96	---	---	---	---	---	3.60	---	---	4
5	---	---	---	8.64	---	---	---	---	---	0	---	---	5
6	---	---	---	8.64	---	---	---	---	---	0	---	---	6
7	---	---	---	5.40	---	---	---	---	---	0	---	---	7
8	---	---	---	0	---	---	---	---	---	0	---	---	8
9	---	---	---	0	0	---	---	---	0	694	---	---	9
10	---	---	---	---	0	---	---	---	0	4827	---	---	10
11	---	---	---	25.2	0	---	---	---	---	1986	---	---	11
12	---	---	---	16.9	0	---	---	---	---	175	---	---	12
13	---	---	---	8.64	329	---	---	---	---	92.2	---	---	13
14	---	---	---	8.64	35.3	---	---	---	4524	42.1	---	---	14
15	---	---	---	8.64	6.84	---	---	---	20989	11.5	---	---	15
16	---	---	---	8.64	379	---	---	---	6921	---	---	---	16
17	---	---	---	6.84	72.0	---	---	---	424	---	---	---	17
18	---	---	---	0	3.60	---	---	---	5.04	---	---	---	18
19	---	---	---	---	---	---	---	---	3141	---	---	---	19
20	---	---	---	---	---	---	---	---	576	---	---	---	20
21	---	---	---	---	---	---	---	---	10.1	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	112	---	---	---	---	---	---	---	30
31	---		---		340		---	---		---		---	31
TOTAL	---	---	---	110#	1280#	226#	---	---	36593#	7833#	---	---	TOTAL
MEAN	---	---	---	7.87	106	113	---	---	3659	559	---	---	MEAN
ST.D.	---	---	---	6.76	151	34.6	---	---	6544	1341	---	---	ST.D.
MAX	---	---	---	25.2	379	137	---	---	20989	4827	---	---	MAX
MIN	---	---	---	0	0	88.9	---	---	0	0	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	0.183	2.75	0.999	---	---	152	35.0	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 46044
DRAINAGE AREA (hectares), 13.8

TOTAL DAILY DISCHARGE FOR 1991 Essex Test Microbasin 1 (ETB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	0	1
2	---	---	---	---	---	---	---	---	---	---	---	0	2
3	---	---	---	---	---	---	---	---	---	---	---	8.64	3
4	---	---	---	---	---	---	---	---	---	---	---	0	4
5	---	---	---	---	---	---	---	---	---	---	---	0	5
6	---	---	---	---	---	---	---	---	---	---	---	0	6
7	---	---	---	---	---	---	---	---	---	---	---	0	7
8	---	---	---	---	---	---	---	---	---	---	---	0	8
9	---	---	---	---	---	---	---	---	---	---	---	2.52	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	0	---	14
15	---	---	---	---	---	---	---	---	---	---	0	---	15
16	---	---	---	---	---	---	---	---	---	---	0	---	16
17	---	---	---	---	---	---	---	---	---	---	0	---	17
18	---	---	---	---	---	---	---	---	---	---	0.720	---	18
19	---	---	---	---	---	---	---	---	---	---	6.12	---	19
20	---	---	---	---	---	---	---	---	---	---	55.1	---	20
21	---	---	---	---	---	---	---	---	---	---	10.8	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	2.88	---	29
30	---		---	---	---	---	---	---	---	---	3.60	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	---	---	---	---	---	---	---	---	79.2#	11.2#	TOTAL
MEAN	---	---	---	---	---	---	---	---	---	---	7.92	1.24	MEAN
ST.D.	---	---	---	---	---	---	---	---	---	---	16.9	2.90	ST.D.
MAX	---	---	---	---	---	---	---	---	---	---	55.1	8.64	MAX
MIN	---	---	---	---	---	---	---	---	---	---	0	0	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	---	---	---	---	---	---	1.04	0.163	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 90.4
DRAINAGE AREA (hectares), 5.3

TOTAL DAILY DISCHARGE FOR 1991 Essex Test Microbasin 2 (ETB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	0	---	14
15	---	---	---	---	---	---	---	---	---	---	0	---	15
16	---	---	---	---	---	---	---	---	---	---	0	---	16
17	---	---	---	---	---	---	---	---	---	---	0	---	17
18	---	---	---	---	---	---	---	---	---	---	0	---	18
19	---	---	---	---	---	---	---	---	---	---	0	---	19
20	---	---	---	---	---	---	---	---	---	---	38.9	---	20
21	---	---	---	---	---	---	---	---	---	---	5.40	---	21
22	---	---	---	---	---	---	---	---	---	---	0	---	22
23	---	---	---	---	---	---	---	---	---	---	0	---	23
24	---	---	---	---	---	---	---	---	---	---	0	---	24
25	---	---	---	---	---	---	---	---	---	---	0	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	---	---	---	---	---	---	---	---	44.3#	---	TOTAL
MEAN	---	---	---	---	---	---	---	---	---	---	3.69	---	MEAN
ST.D.	---	---	---	---	---	---	---	---	---	---	11.2	---	ST.D.
MAX	---	---	---	---	---	---	---	---	---	---	38.9	---	MAX
MIN	---	---	---	---	---	---	---	---	---	---	0	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	---	---	---	---	---	---	0.637	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 44.3
DRAINAGE AREA (hectares), 6.1

/charge/4100./data/loadsmicro/ecb1.flow91.out Wed Dec 9 14:10:42 1992

TOTAL DAILY DISCHARGE FOR 1991 Essex Control Microbasin 1 (ECB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	0	---	1
2	---	---	---	---	---	---	---	---	---	---	---	0	2
3	---	---	---	---	---	---	---	---	---	---	---	0	3
4	---	---	---	---	---	---	---	---	---	---	---	0	4
5	---	---	---	---	---	---	---	---	---	---	0	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	0	12
13	---	---	---	---	---	---	---	---	---	---	---	0	13
14	---	---	---	---	---	---	---	---	---	---	0	---	14
15	---	---	---	---	---	---	---	---	---	---	0	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	0	---	18
19	---	---	---	---	---	---	---	---	---	---	0	---	19
20	---	---	---	---	---	---	---	---	---	---	1.08	---	20
21	---	---	---	---	---	---	---	---	---	---	0	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	0	0	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	0	---	---	28
29	---		---	---	---	---	---	---	---	---	0	---	29
30	---		---	---	---	---	---	---	---	0	0	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	---	---	---	---	---	---	---	0 #	1.08#	0 #	TOTAL
MEAN	---	---	---	---	---	---	---	---	---	0	0.0982	0	MEAN
ST.D.	---	---	---	---	---	---	---	---	---	0	0.326	0	ST.D.
MAX	---	---	---	---	---	---	---	---	---	0	1.08	0	MAX
MIN	---	---	---	---	---	---	---	---	---	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	---	---	---	---	---	---	0.0132	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 1.08
DRAINAGE AREA (hectares), 8.2

/charge/4100./data/loadsmicro/ecb2.flow91.out Wed Dec 9 14:10:59 1992

TOTAL DAILY DISCHARGE FOR 1991 Essex Control Microbasin 2 (ECB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	37.8	---	---	---	---	9.72	0	1
2	---	---	---	---	---	0	---	---	---	---	6.12	0	2
3	---	---	---	---	---	0	---	---	---	---	0	64.1	3
4	---	---	---	---	---	---	---	---	---	---	0	1.08	4
5	---	---	---	---	---	---	---	---	---	---	0	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	0	---	---	---	---	---	---	14
15	---	---	---	---	---	0	---	---	---	---	0	---	15
16	---	---	---	---	---	0	---	---	---	---	0	---	16
17	---	---	---	---	---	0	---	---	---	---	0	---	17
18	---	---	---	---	---	0	---	---	---	---	5.04	---	18
19	---	---	---	---	---	0	---	---	---	---	6.12	---	19
20	---	---	---	---	---	---	---	---	---	---	75.2	---	20
21	---	---	---	---	---	---	---	---	---	---	19.1	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	0	---	---	---	---	---	---	---	23
24	---	---	---	---	0	---	---	---	---	---	---	---	24
25	---	---	---	---	0	---	---	---	---	25.2	---	---	25
26	---	---	---	---	6.84	---	---	---	---	45.4	---	---	26
27	---	---	---	---	0	---	---	---	---	10.4	---	---	27
28	---	---	---	---	0	---	---	---	---	0	---	---	28
29	---		---	---	0	---	---	---	---	0	2.16	---	29
30	---		---	---	0	---	---	---	---	0	0	---	30
31	---		---		0.360		---	---		0		---	31
TOTAL	---	---	---	---	7.20#	37.8#	---	---	---	81.0#	123#	65.2#	TOTAL
MEAN	---	---	---	---	0.800	4.20	---	---	---	11.6	8.82	16.3	MEAN
ST.D.	---	---	---	---	2.27	12.6	---	---	---	17.6	19.9	31.9	ST.D.
MAX	---	---	---	---	6.84	37.8	---	---	---	45.4	75.2	64.1	MAX
MIN	---	---	---	---	0	0	---	---	---	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	0.0496	0.274	---	---	---	0.329	0.545	0.464	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 314
DRAINAGE AREA (hectares), 13.8

/charge/4100./data/loadsmicro/etb1.flow92.out Wed Dec 9 19:18:22 1992

TOTAL DAILY DISCHARGE FOR 1992 Essex Test Microbasin 1 (ETB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	18.7	---	---	---	---	---	---	---	---	---	25
26	---	---	106	---	---	---	---	---	---	---	---	---	26
27	---	---	83.2	---	---	---	---	---	---	---	---	---	27
28	---	---	5.76	---	---	---	---	---	---	---	---	---	28
29	---	---	0	---	---	---	---	---	---	---	---	---	29
30	---		0	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	214#	---	---	---	---	---	---	---	---	---	TOTAL
MEAN	---	---	35.8	---	---	---	---	---	---	---	---	---	MEAN
ST.D.	---	---	47.0	---	---	---	---	---	---	---	---	---	ST.D.
MAX	---	---	106	---	---	---	---	---	---	---	---	---	MAX
MIN	---	---	0	---	---	---	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	2.02	---	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 214
DRAINAGE AREA (hectares), 5.3

/charge/4100./data/loadsmicro/etb2.flow92.out Wed Dec 9 19:16:33 1992

TOTAL DAILY DISCHARGE FOR 1992 Essex Test Microbasin 2 (ETB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---	---	---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	---	---	---	---	---	---	---	---	---	---	TOTAL
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	MEAN
ST.D.	---	---	---	---	---	---	---	---	---	---	---	---	ST.D.
MAX	---	---	---	---	---	---	---	---	---	---	---	---	MAX
MIN	---	---	---	---	---	---	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 0
DRAINAGE AREA (hectares), 6.1

/charge/4100./data/loadsmicro/ecb1.flow92.out Wed Dec 9 19:18:04 1992

TOTAL DAILY DISCHARGE FOR 1992 Essex Control Microbasin 1 (ECB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	0	---	---	---	---	---	---	---	---	---	9
10	---	---	62.6	---	---	---	---	---	---	---	---	---	10
11	---	---	0.360	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	0	---	---	---	---	---	---	---	---	---	25
26	---	---	127	---	---	---	---	---	---	---	---	---	26
27	---	---	102	---	---	---	---	---	---	---	---	---	27
28	---	---	6.12	---	---	---	---	---	---	---	---	---	28
29	---	---	---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	299#	---	---	---	---	---	---	---	---	---	TOTAL
MEAN	---	---	42.7	---	---	---	---	---	---	---	---	---	MEAN
ST.D.	---	---	54.7	---	---	---	---	---	---	---	---	---	ST.D.
MAX	---	---	127	---	---	---	---	---	---	---	---	---	MAX
MIN	---	---	0	---	---	---	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	1.56	---	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 299
DRAINAGE AREA (hectares), 8.2

TOTAL DAILY DISCHARGE FOR 1992 Essex Control Microbasin 2 (ECB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	0	---	---	---	---	---	---	---	---	---	9
10	---	---	413	---	---	---	---	---	---	---	---	---	10
11	---	---	2.16	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	68.4	---	---	---	---	---	---	---	---	---	25
26	---	---	275	---	---	---	---	---	---	---	---	---	26
27	---	---	422	---	---	---	---	---	---	---	---	---	27
28	---	---	21.6	---	---	---	---	---	---	---	---	---	28
29	---	---	0.360	---	---	---	---	---	---	---	---	---	29
30	---		0.360	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	1203#	---	---	---	---	---	---	---	---	---	TOTAL
MEAN	---	---	133	---	---	---	---	---	---	---	---	---	MEAN
ST.D.	---	---	183	---	---	---	---	---	---	---	---	---	ST.D.
MAX	---	---	422	---	---	---	---	---	---	---	---	---	MAX
MIN	---	---	0	---	---	---	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	3.06	---	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 1203
DRAINAGE AREA (hectares), 13.8

KETTLE CREEK MICROBASIN TOTAL DAILY RUNOFF

/charge/4100./data/loadsmicro/ktb1.flow90.out Wed Dec 9 11:27:44 1992

TOTAL DAILY DISCHARGE FOR 1990 Kettle Test Microbasin 1 (KTB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	33.5	---	---	---	---	---	1
2	---	---	---	---	---	---	0	---	---	---	---	---	2
3	---	---	---	---	---	---	0	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	0	---	---	4
5	---	---	---	---	---	---	---	---	---	---	6922	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	0	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	106	---	---	9
10	---	---	---	---	---	---	---	0	---	---	---	---	10
11	---	---	---	---	---	---	---	0	---	---	---	---	11
12	---	---	---	---	---	---	---	51.1	---	0.720	---	---	12
13	---	---	---	---	---	---	---	559	---	---	---	---	13
14	---	---	---	---	---	---	0	0	128	---	---	---	14
15	---	---	---	---	0	---	---	---	---	---	---	---	15
16	---	---	---	---	763	---	---	0	---	---	---	---	16
17	---	---	---	---	584	---	---	0	---	---	---	---	17
18	---	---	---	---	0	---	---	0	---	114	---	---	18
19	---	---	---	---	0	---	---	0	---	---	---	---	19
20	---	---	---	---	---	---	---	0	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	0	---	---	---	---	---	---	22
23	---	---	---	---	---	234	---	---	---	---	---	---	23
24	---	---	---	---	---	99.0	---	---	---	---	---	---	24
25	---	---	---	---	---	0	---	---	---	---	---	---	25
26	---	---	---	---	---	0	---	---	---	---	---	---	26
27	---	---	---	---	---	0	---	---	---	---	---	---	27
28	---	---	---	---	---	0	---	5969	---	---	---	---	28
29	---		---	---	---	0	---	---	---	---	---	---	29
30	---		---	---	---	0	0	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	---	---	1347#	333#	33.5#	6579#	128#	222#	6922#	---	TOTAL
MEAN	---	---	---	---	269	33.3	6.70	598	128	55.5	6922	---	MEAN
ST.D.	---	---	---	---	374	77.2	15.0	1789	---	63.8	---	---	ST.D.
MAX	---	---	---	---	763	234	33.5	5969	128	114	6922	---	MAX
MIN	---	---	---	---	0	0	0	0	128	0	999	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	12.7	3.91	0.558	99.5	2.15	1.91	115	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 15567
DRAINAGE AREA (hectares), 6.0

TOTAL DAILY DISCHARGE FOR 1990 Kettle Test Microbasin 2 (KTB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	0	---	---	---	0	---	---	---	---	1
2	---	---	---	0	---	---	---	0	---	---	0	---	2
3	---	---	---	---	---	---	---	---	---	---	0	---	3
4	---	---	---	---	---	---	---	---	---	1.08	0	---	4
5	---	---	---	---	---	---	---	---	---	---	838	---	5
6	---	---	---	0	---	0	---	---	0	---	63.0	---	6
7	---	---	---	0	---	0	---	---	---	---	0	---	7
8	---	---	---	0	---	0.360	---	---	---	---	0	---	8
9	---	---	---	0	---	0	---	---	---	34.2	0	---	9
10	---	---	---	65.5	---	0	---	---	---	45.0	0	---	10
11	---	---	---	2.52	---	---	---	---	---	149	---	---	11
12	---	---	37.4	0	---	---	---	---	---	148	---	---	12
13	---	---	0	0	---	---	---	---	---	0	---	---	13
14	---	---	0	---	---	---	0	---	44.6	0	---	---	14
15	---	---	0	---	0	---	0	---	---	---	---	---	15
16	---	---	2.16	---	38.2	---	0	---	---	---	---	---	16
17	---	---	0	---	50.4	---	0	---	---	0	---	---	17
18	---	---	0	---	0	---	0	---	---	1422	---	---	18
19	---	---	---	0	0	---	---	---	---	0	---	---	19
20	---	---	---	0	---	---	---	---	---	---	---	---	20
21	---	---	---	0	---	---	---	---	---	---	0	---	21
22	---	---	---	0	---	---	---	---	---	---	14.4	---	22
23	---	---	---	0	---	13.3	---	---	---	---	0	---	23
24	---	---	---	---	---	---	---	---	---	---	0	---	24
25	---	---	---	---	---	---	---	---	---	---	0	---	25
26	---	---	---	---	---	---	---	---	---	---	0	---	26
27	---	---	---	---	---	---	---	---	---	---	7.56	---	27
28	---	---	---	---	---	---	---	---	---	---	2.52	---	28
29	---		0	---	---	---	---	---	---	---	---	---	29
30	---		0	---	---	---	0	---	---	---	---	---	30
31	---		0		---		0	---		---		---	31
TOTAL	---	---	39.6#	68.0#	88.6#	13.7#	0 #	0 #	44.6#	1800#	926#	---	TOTAL
MEAN	---	---	3.96	4.54	17.7	2.28	0	0	22.3	180	54.5	---	MEAN
ST.D.	---	---	11.8	16.9	24.6	5.41	0	0	31.6	440	202	---	ST.D.
MAX	---	---	37.4	65.5	50.4	13.3	0	0	44.6	1422	838	---	MAX
MIN	---	---	0	0	0	0	0	0	0	0	0	---	MIN
MAX DLY AVG AREA FLOWS	---	---	0.734	1.28	0.988	0.261	---	---	0.875	27.9	16.4	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 2981
DRAINAGE AREA (hectares), 5.1

/charge/4100./data/loadsmicro/kcb1.flow89.out Wed Dec 9 11:13:40 1992

TOTAL DAILY DISCHARGE FOR 1989 Kettle Control Microbasin 1 (KCB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	---	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	---	---	---	---	---	---	---	---	---	23
24	---	---	---	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---		---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	---	---	---	---	---	---	---	---	---	---	TOTAL
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	MEAN
ST.D.	---	---	---	---	---	---	---	---	---	---	---	---	ST.D.
MAX	---	---	---	---	---	---	---	---	---	---	---	---	MAX
MIN	---	---	---	---	---	---	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	---	---	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 0
DRAINAGE AREA (hectares), 8.5

/charge/4100./data/loadsmicro/kcb1.flow90.out Wed Dec 9 11:27:29 1992

TOTAL DAILY DISCHARGE FOR 1990 Kettle Control Microbasin 1 (KCB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	0	---	---	0	0	0	0	---	0	1
2	---	---	---	0	---	0	0	0	0	0	0	0	2
3	---	---	---	---	---	0	0	---	0	0	0	1.08	3
4	---	---	---	---	---	0	0	---	0	621	0	1095	4
5	---	---	---	---	---	0	0	---	0	0	3586	---	5
6	---	---	---	---	---	0	0	---	16.6	0	755	---	6
7	---	---	---	---	---	0	0	---	82.8	0	0	---	7
8	---	---	---	---	---	18.4	---	---	0	0	0	---	8
9	---	---	---	---	---	0	---	---	---	1086	59.4	---	9
10	---	---	---	0	---	0	---	---	---	385	7.20	---	10
11	---	---	---	8.28	0	0	---	---	---	931	---	---	11
12	---	---	---	0	0	0	---	---	---	1047	---	---	12
13	---	---	144	0	2.52	0	---	---	---	43.6	---	---	13
14	---	---	29.2	4.32	0	0	219	---	1567	1.44	---	---	14
15	---	---	17.3	5.04	0	0	47.2	---	199	0	---	---	15
16	---	---	37.4	0	237	0	0	---	0	0	0	---	16
17	---	---	15.1	3.60	790	0	0	---	0	0	0	---	17
18	---	---	3.60	---	9.36	0	0	---	0	1184	0	---	18
19	---	---	3.24	0	0	---	0	---	0	0	0	---	19
20	---	---	2.16	4.32	113	---	0	---	---	0	0	---	20
21	---	---	3.24	14.8	4.32	---	0	---	1.80	---	0	---	21
22	---	---	9.00	0	0	0	0	---	2.52	---	565	---	22
23	---	---	34.2	0	0	16.9	2.52	---	2.52	---	10.4	---	23
24	---	---	---	---	0	0	0	0	5.40	---	2.88	---	24
25	---	---	---	---	0	0	0	0	0	---	---	---	25
26	---	---	---	---	---	0	0	0	0	---	0	---	26
27	---	---	---	---	---	0	---	93.6	0	---	366	---	27
28	---	---	---	---	---	0	---	4036	0	---	523	---	28
29	---		0	---	---	0	---	44.6	0	---	3.24	---	29
30	---		5.76	---	---	1.44	94.7	0.360	0	---	0	---	30
31	---		2.52		---		0	0		---		---	31
TOTAL	---	---	307#	40.3#	1158#	36.7#	363#	4175#	1878#	5301#	5880#	1096#	TOTAL
MEAN	---	---	21.9	2.69	77.2	1.41	16.5	417	78.3	265	255	274	MEAN
ST.D.	---	---	37.4	4.26	207	4.79	50.4	1272	320	440	758	547	ST.D.
MAX	---	---	144	14.8	790	18.4	219	4036	1567	1184	3586	1095	MAX
MIN	---	---	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	---	1.70	0.174	9.30	0.216	2.58	47.5	18.4	13.9	42.2	12.9	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 20238
DRAINAGE AREA (hectares), 8.5

TOTAL DAILY DISCHARGE FOR 1990 Kettle Control Microbasin 2 (KCB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	19.1	---	---	---	---	0	---	---	0	1
2	---	---	---	133	---	0	---	0	0	---	0	0	2
3	---	---	---	47.5	---	0	---	0	0	0	0	0	3
4	---	---	---	22.3	---	0	---	0	0	203	0	---	4
5	---	---	---	9.72	---	0	---	0	0	3.24	403	---	5
6	---	---	---	3.96	---	0	---	0	84.6	0	306	---	6
7	---	---	---	0	---	0	---	0	94.7	0	38.9	---	7
8	---	---	---	0	---	0	---	---	0	0	9.72	---	8
9	---	---	---	0	---	---	---	---	---	311	0	---	9
10	---	---	---	163	---	---	---	0	---	218	---	---	10
11	---	---	---	61.6	0	---	---	0	---	394	---	---	11
12	---	---	---	5.76	0	---	---	0	---	515	---	---	12
13	---	---	---	0	33.8	---	---	1.80	---	219	---	---	13
14	---	---	65.2	10.8	0	0	10.8	0	252	41.0	---	---	14
15	---	---	63.7	10.1	---	0	---	0	---	13.0	---	---	15
16	---	---	163	2.16	185	0	---	0	---	4.68	0	---	16
17	---	---	28.8	10.8	221	0	---	0	---	0	0	---	17
18	---	---	7.20	0	16.2	0	---	0	---	469	0	---	18
19	---	---	17.3	0	0	0	---	0	---	51.1	0	---	19
20	---	---	12.2	39.6	99.4	0	---	---	---	15.1	0	---	20
21	---	---	23.4	55.4	14.0	---	---	---	---	0	0	---	21
22	---	---	107	0	0	0	---	---	---	---	0	---	22
23	---	---	38.9	0	---	0	---	---	---	---	0	---	23
24	---	---	0	0	---	0	---	---	---	---	0	---	24
25	---	---	---	0	---	0	---	---	---	---	---	---	25
26	---	---	---	0	---	0	---	---	---	---	0	---	26
27	---	---	---	0	---	0	---	---	---	---	102	---	27
28	---	---	---	---	---	0	---	10.8	---	---	139	---	28
29	---		0	---	---	---	---	3.60	---	---	30.2	---	29
30	---		23.4	---	---	---	0.720	---	---	---	3.96	---	30
31	---		13.3		---		---	0		---		---	31
TOTAL	---	---	564#	595#	570#	0 #	11.5#	16.2#	431#	2461#	1033#	0 #	TOTAL
MEAN	---	---	40.3	22.1	51.9	0	5.76	0.853	48.0	129	47.0	0	MEAN
ST.D.	---	---	46.4	40.9	80.9	0	7.13	2.57	86.0	176	106	0	ST.D.
MAX	---	---	163	163	221	0	10.8	10.8	252	515	403	0	MAX
MIN	---	---	0	0	0	0	0.720	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	---	3.99	3.98	5.40	---	0.263	0.263	6.16	12.6	9.84	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 5686
DRAINAGE AREA (hectares), 4.1

TOTAL DAILY DISCHARGE FOR 1991 Kettle Test Microbasin 1 (KTB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0	0	0	0	0	0	0	0	0	0	0	1
2	---	0	182	0	0	0	0	0	0	0	0	0	2
3	---	0	24.5	0	0	0	0	0	0	0	0	0	3
4	---	0	0	0	0	0	0	0	0	0	0	0	4
5	---	0	133	0	0	0	0	0	0	0	0	0	5
6	---	0	13347	0	0	0	0	0	0	0	0	0	6
7	---	0	3.60	0	0	0	0	0	0	0	0	0	7
8	---	0	0	0	0	0	0	0	0	0	0	0	8
9	---	0	0	0	0	0	0	0	0	0	0	0	9
10	---	0	0	0	0	0	0	0	0	0	0	0	10
11	---	0	0	0	0	0	0	0	0	0	0	0	11
12	---	0	36071	0	0	0	0	0	0	0	0	0	12
13	---	0	0	0	0	0	0	0	0	0	0	0	13
14	---	0	0	0	0	0	0	0	0	0	0	0	14
15	---	0	0	22.3	0	0	0	0	0	0	0	0	15
16	---	0	0	0	0	0	0	0	0	0	0	0	16
17	---	0	0	0	0	0	0	0	0	0	0	0	17
18	---	0	677	0	0	0	0	0	0	0	0	0	18
19	---	0	0	0	0	0	0	0	0	0	0	0	19
20	---	0	0	836	0	0	0	0	0	0	0	0	20
21	---	0	0	0	0	0	0	0	0	0	0	0	21
22	---	0	0	0	0	0	0	0	0	0	0	0	22
23	---	0	30.2	0	0	0	0	0	0	0	0	0	23
24	---	0	0	0	0	0	0	0	0	0	0	0	24
25	---	0	0	0	0	0	0	0	0	0	0	0	25
26	---	0	0	0	31.7	0	0	0	0	0	0	0	26
27	---	0	0	0	0	0	0	0	0	0	0	0	27
28	---	0	11.9	0	0	0	0	0	0	0	0	0	28
29	---		0	0	0	0	0	0	0	0	0	0	29
30	---		0	0	0	0	0	0	0	0	0	0	30
31	---		0		0		0	0		0		0	31
TOTAL	---	0	50483	858	31.7	0	0	0	0	0	0	0	TOTAL
MEAN	---	0	1628	28.6	1.02	0	0	0	0	0	0	0	MEAN
ST.D.	---	0	6825	152	5.69	0	0	0	0	0	0	0	ST.D.
MAX	---	0	36071	836	31.7	0	0	0	0	0	0	0	MAX
MIN	---	0	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	---	601	13.9	0.528	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 51373
DRAINAGE AREA (hectares), 6.0

TOTAL DAILY DISCHARGE FOR 1991 Kettle Test Microbasin 2 (KTB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	7.20	---	---	0	---	---	---	---	---	---	1
2	---	---	562	---	---	---	---	---	---	---	---	---	2
3	---	---	9.72	---	---	---	---	---	---	---	---	---	3
4	---	342	0	0	---	---	---	---	---	---	---	---	4
5	---	---	0	0	---	---	---	---	---	---	---	---	5
6	---	---	735	0	---	---	---	---	---	---	---	---	6
7	---	---	12.6	0	---	---	---	---	---	---	---	---	7
8	---	---	0	0	---	---	---	---	---	---	---	0	8
9	---	---	---	4.68	---	---	---	---	---	---	---	0	9
10	---	---	---	0	---	---	---	---	---	---	---	---	10
11	---	---	---	0	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	29.9	---	---	---	---	---	---	---	---	15
16	---	---	---	---	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	58.0	---	---	---	---	---	---	---	---	---	18
19	---	---	0	0	---	---	---	---	---	---	---	---	19
20	---	---	0	41.8	---	---	---	---	---	---	---	---	20
21	---	---	0	0	---	---	---	---	---	---	---	---	21
22	---	---	0	0	---	---	---	---	---	---	---	---	22
23	---	---	0	---	---	---	---	---	---	---	---	---	23
24	---	---	0	---	---	---	---	---	---	---	---	---	24
25	---	---	---	---	---	---	---	---	---	---	---	---	25
26	---	---	0	---	---	---	---	---	---	---	---	---	26
27	---	---	6.48	---	---	---	---	---	---	---	---	---	27
28	---	---	7.20	---	0	---	---	---	---	---	---	---	28
29	---		0	---	0	---	---	---	---	---	---	---	29
30	---		0	---	0	---	---	---	---	---	---	---	30
31	---		---		0		---	---		---		---	31
TOTAL	---	342#	1399#	76.3#	0 #	0 #	---	---	---	---	---	0 #	TOTAL
MEAN	---	342	70.0	5.87	0	0	---	---	---	---	---	0	MEAN
ST.D.	---	---	200	13.6	0	---	---	---	---	---	---	0	ST.D.
MAX	---	342	735	41.8	0	0	---	---	---	---	---	0	MAX
MIN	---	342	0	0	0	0	---	---	---	---	---	0	MIN
MAX DLY AVG AREA FLOWS	---	6.71	14.4	0.819	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 1818
DRAINAGE AREA (hectares), 5.1

TOTAL DAILY DISCHARGE FOR 1991 Kettle Control Microbasin 1 (KCB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	353	0	---	---	---	---	---	---	---	0	1
2	---	---	3021	---	---	---	---	---	---	---	---	0	2
3	---	---	246	---	---	---	---	---	---	---	---	0	3
4	---	983	7.20	0	---	---	---	---	---	---	---	0	4
5	---	---	457	0	---	---	---	---	---	---	---	0	5
6	---	---	4240	0	---	---	---	---	---	---	---	0	6
7	---	---	198	0	---	---	---	---	---	---	---	389	7
8	---	---	0	0	---	---	---	---	---	---	---	18.4	8
9	---	---	0	0	---	---	---	---	---	---	---	14.4	9
10	---	---	2.88	0	---	---	---	---	---	---	---	0	10
11	---	---	0	0	---	---	---	---	---	---	---	0	11
12	---	---	0	0	---	---	---	---	---	---	---	0	12
13	---	---	0	0	---	---	---	---	---	---	---	0	13
14	---	---	1.08	0	---	---	---	---	---	---	0	---	14
15	---	---	3.24	13.0	---	---	---	---	---	---	0	---	15
16	---	---	---	0	---	---	---	---	---	---	0	---	16
17	---	---	---	0	---	---	---	---	---	---	0	---	17
18	---	---	1195	---	---	---	---	---	---	---	0	---	18
19	---	---	119	1.80	---	---	---	---	---	---	0	---	19
20	---	---	0	907	---	---	---	---	---	---	0	---	20
21	---	---	0	34.6	---	---	---	---	---	---	0	---	21
22	---	---	0	5.76	---	---	---	---	---	---	0	---	22
23	---	---	32.0	0	0	---	---	---	---	---	0	---	23
24	---	---	32.8	0	0	---	---	---	---	1.08	0	---	24
25	---	---	6.48	---	0	---	---	---	---	7.92	0	---	25
26	---	---	0	---	6.48	---	---	---	---	1.80	0	---	26
27	---	---	1031	---	0	---	---	---	---	0	0.720	---	27
28	---	---	363	---	0	---	---	---	---	0	8.64	---	28
29	---		0	---	0	---	---	---	---	---	13.0	---	29
30	---		0	---	0	---	---	---	---	---	4.32	---	30
31	---		0		---		---	---		---		---	31
TOTAL	---	983#	11312#	962#	6.48#	---	---	---	---	10.8#	26.6#	421#	TOTAL
MEAN	---	983	390	45.8	0.810	---	---	---	---	2.16	1.57	32.5	MEAN
ST.D.	---	---	959	197	2.29	---	---	---	---	3.31	3.71	107	ST.D.
MAX	---	983	4240	907	6.48	---	---	---	---	7.92	13.0	389	MAX
MIN	---	983	0	0	0	---	---	---	---	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	11.6	49.9	10.7	0.0762	---	---	---	---	0.0932	0.152	4.58	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 13725
DRAINAGE AREA (hectares), 8.5

/charge/4100./data/loadsmicro/kcb2.flow91.out Wed Dec 9 14:11:42 1992

TOTAL DAILY DISCHARGE FOR 1991 Kettle Control Microbasin 2 (KCB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	44.3	0	---	0	---	---	0	---	---	---	1
2	---	---	521	---	---	0	---	---	0	---	---	---	2
3	---	---	132	---	---	0	---	---	0	---	---	---	3
4	---	0.720	13.0	0	---	---	---	---	0	---	---	---	4
5	---	---	68.4	0	---	---	---	---	0	---	---	---	5
6	---	---	1019	0.720	---	---	---	---	0	---	---	0	6
7	---	---	113	0	---	---	---	---	0	---	---	51.1	7
8	---	---	33.1	0	---	---	---	---	---	---	---	208	8
9	---	---	20.2	1.08	---	---	---	---	---	---	---	48.2	9
10	---	---	34.6	0	---	0	---	---	---	---	---	0	10
11	---	---	33.8	---	---	0	---	---	---	---	---	---	11
12	---	---	8.64	---	---	0	0	---	---	---	---	---	12
13	---	---	---	---	---	---	0	---	---	---	---	---	13
14	---	---	---	---	---	0	0	---	---	---	0	---	14
15	---	---	---	18.4	---	0	0	---	---	---	0	---	15
16	---	---	---	0	---	0	0	---	---	---	0	---	16
17	---	---	---	---	---	0	0	---	---	---	0	---	17
18	---	---	285	---	---	---	0	---	---	---	0	---	18
19	---	---	75.2	3.60	---	---	0	---	---	---	0	---	19
20	---	---	3.60	97.2	---	---	---	---	---	---	0	---	20
21	---	---	22.7	35.3	---	---	---	---	---	---	0	---	21
22	---	---	14.4	0	---	---	---	---	---	---	---	---	22
23	---	---	43.2	---	0	---	---	---	---	---	0	---	23
24	---	---	62.6	---	0	---	---	---	---	0	---	---	24
25	---	---	32.8	---	15.8	---	---	---	---	0	---	---	25
26	---	---	10.1	---	70.9	---	---	---	---	0	---	---	26
27	---	---	213	---	0	---	---	---	---	0	---	---	27
28	---	---	125	---	0	---	---	---	---	0	---	---	28
29	---		2.52	---	0	---	---	---	---	---	14.8	---	29
30	---		0	---	0	---	---	0	---	---	0	---	30
31	---		0		0		---	0		---		---	31
TOTAL	---	0.720#	2934#	156#	86.8#	0 #	0 #	0 #	0 #	0 #	14.8#	307#	TOTAL
MEAN	---	0.720	112	11.2	9.64	0	0	0	0	0	1.34	61.5	MEAN
ST.D.	---	---	216	26.7	23.6	0	0	0	0	0	4.45	85.6	ST.D.
MAX	---	0.720	1019	97.2	70.9	0	0	0	0	0	14.8	208	MAX
MIN	---	0.720	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	0.0176	24.9	2.37	1.73	---	---	---	---	---	0.360	5.08	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 3500
DRAINAGE AREA (hectares), 4.1

/charge/4100./data/loadsmicro/ktb1.flow92.out Fri Dec 11 13:05:58 1992

TOTAL DAILY DISCHARGE FOR 1992 Kettle Test Microbasin 1 (KTB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	---	---	---	---	---	---	---	---	---	1
2	---	---	---	---	---	---	---	---	---	---	---	---	2
3	---	---	---	---	---	---	---	---	---	---	---	---	3
4	---	---	---	---	---	---	---	---	---	---	---	---	4
5	---	---	---	---	---	---	---	---	---	---	---	---	5
6	---	---	---	---	---	---	---	---	---	---	---	---	6
7	---	---	---	---	---	---	---	---	---	---	---	---	7
8	---	---	---	---	---	---	---	---	---	---	---	---	8
9	---	---	---	---	---	---	---	---	---	---	---	---	9
10	---	---	---	---	---	---	---	---	---	---	---	---	10
11	---	---	---	---	---	---	---	---	---	---	---	---	11
12	---	---	---	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	386	---	---	---	---	---	---	---	---	16
17	---	---	---	---	---	---	---	---	---	---	---	---	17
18	---	---	---	---	---	---	---	---	---	---	---	---	18
19	---	---	---	---	---	---	---	---	---	---	---	---	19
20	---	---	---	---	---	---	---	---	---	---	---	---	20
21	---	---	---	1.08	---	---	---	---	---	---	---	---	21
22	---	---	---	---	---	---	---	---	---	---	---	---	22
23	---	---	---	1.08	---	---	---	---	---	---	---	---	23
24	---	---	---	1089	---	---	---	---	---	---	---	---	24
25	---	---	150	---	---	---	---	---	---	---	---	---	25
26	---	---	---	---	---	---	---	---	---	---	---	---	26
27	---	---	---	---	---	---	---	---	---	---	---	---	27
28	---	---	---	---	---	---	---	---	---	---	---	---	28
29	---	---	---	---	---	---	---	---	---	---	---	---	29
30	---		---	---	---	---	---	---	---	---	---	---	30
31	---		---		---		---	---		---		---	31
TOTAL	---	---	150#	1477#	---	---	---	---	---	---	---	---	TOTAL
MEAN	---	---	150	369	---	---	---	---	---	---	---	---	MEAN
ST.D.	---	---	---	512	---	---	---	---	---	---	---	---	ST.D.
MAX	---	---	150	1089	---	---	---	---	---	---	---	---	MAX
MIN	---	---	150	1.08	---	---	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	2.50	18.2	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 1627
DRAINAGE AREA (hectares), 6.0

/charge/4100./data/loadsmicro/ktb2.flow92.out Wed Dec 9 19:19:07 1992

TOTAL DAILY DISCHARGE FOR 1992 Kettle Test Microbasin 2 (KTB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	0	0	0	---	---	---	---	---	---	1
2	---	---	---	0	0	0	---	---	---	---	---	---	2
3	---	---	---	0	0	0	---	---	---	---	---	---	3
4	---	---	183	0	0	0	---	---	---	---	---	---	4
5	---	---	34.2	0	0	0	---	---	---	---	---	---	5
6	---	---	2624	0	0	0	---	---	---	---	---	---	6
7	---	---	20820	0	0	0	---	---	---	---	---	---	7
8	---	---	25457	0	0	0	---	---	---	---	---	---	8
9	---	---	839	0	0	0	---	---	---	---	---	---	9
10	---	---	1155	0	0	0	---	---	---	---	---	---	10
11	---	---	0	0	0	0	---	---	---	---	---	---	11
12	---	---	0	0	0	0	---	---	---	---	---	---	12
13	---	---	0	0	0	0	---	---	---	---	---	---	13
14	---	---	0	0	0	0	---	---	---	---	---	---	14
15	---	---	0	0	0	0	---	---	---	---	---	---	15
16	---	---	0	580	0	0	---	---	---	---	---	---	16
17	---	---	0	0	0	0	---	---	---	---	---	---	17
18	---	---	0	0	0	0	---	---	---	---	---	---	18
19	---	---	0	0	0	0	---	---	---	---	---	---	19
20	---	---	0	0	0	0	---	---	---	---	---	---	20
21	---	---	0	1.44	0	0	---	---	---	---	---	---	21
22	---	---	0	0	0	0	---	---	---	---	---	---	22
23	---	---	0	1.08	0	0	---	---	---	---	---	---	23
24	---	---	0	1756	0	0	---	---	---	---	---	---	24
25	---	---	226	0	0	0	---	---	---	---	---	---	25
26	---	---	0	0	0	0	---	---	---	---	---	---	26
27	---	---	0	0	0	0	---	---	---	---	---	---	27
28	---	---	0	0	0	0	---	---	---	---	---	---	28
29	---	---	0	0	0	0	---	---	---	---	---	---	29
30	---		0	0	0	0	---	---	---	---	---	---	30
31	---		0		0		---	---		---		---	31
TOTAL	---	---	513424	2339	0	0	---	---	---	---	---	---	TOTAL
MEAN	---	---	1833	78.0	0	0	---	---	---	---	---	---	MEAN
ST.D.	---	---	6075	334	0	0	---	---	---	---	---	---	ST.D.
MAX	---	---	25457	1756	0	0	---	---	---	---	---	---	MAX
MIN	---	---	0	0	0	0	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	499	34.4	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 53681
DRAINAGE AREA (hectares), 5.1

/charge/4100./data/loadsmicro/kcb1.flow92.out Wed Dec 9 19:18:41 1992

TOTAL DAILY DISCHARGE FOR 1992 Kettle Control Microbasin 1 (KCB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	6.48	0	---	---	---	---	---	---	---	---	1
2	---	---	0	0	---	---	---	---	---	---	---	---	2
3	---	---	0	0	---	---	---	---	---	---	---	---	3
4	---	---	10.4	0	---	---	---	---	---	---	---	---	4
5	---	---	23.4	0	---	---	---	---	---	---	---	---	5
6	---	---	168	---	---	---	---	---	---	---	---	---	6
7	---	---	783	---	---	---	---	---	---	---	---	---	7
8	---	---	50.8	---	---	---	---	---	---	---	---	---	8
9	---	---	0	---	---	---	---	---	---	---	---	---	9
10	---	---	46.8	---	---	---	---	---	---	---	---	---	10
11	---	---	0	---	---	---	---	---	---	---	---	---	11
12	---	---	0.360	---	---	---	---	---	---	---	---	---	12
13	---	---	---	---	---	---	---	---	---	---	---	---	13
14	---	---	---	---	---	---	---	---	---	---	---	---	14
15	---	---	---	---	---	---	---	---	---	---	---	---	15
16	---	---	---	829	---	---	---	---	---	---	---	---	16
17	---	10.8	---	0	---	---	---	---	---	---	---	---	17
18	---	67.3	---	0	---	---	---	---	---	---	---	---	18
19	---	514	---	0	---	---	---	---	---	---	---	---	19
20	---	172	---	0	---	---	---	---	---	---	---	---	20
21	---	126	---	5.40	---	---	---	---	---	---	---	---	21
22	---	87.8	---	0	---	---	---	---	---	---	---	---	22
23	---	82.8	---	24.1	---	---	---	---	---	---	---	---	23
24	---	82.1	---	1101	---	---	---	---	---	---	---	---	24
25	---	23.4	---	2.52	---	---	---	---	---	---	---	---	25
26	---	7.20	---	0	---	---	---	---	---	---	---	---	26
27	---	---	---	0	---	---	---	---	---	---	---	---	27
28	---	23.8	---	0	---	---	---	---	---	---	---	---	28
29	---	7.56	---	0	---	---	---	---	---	---	---	---	29
30	---		0	0	---	---	---	---	---	---	---	---	30
31	---		0		---		---	---		---		---	31
TOTAL	---	1206#	1090#	1962#	---	---	---	---	---	---	---	---	TOTAL
MEAN	---	100	77.9	98.1	---	---	---	---	---	---	---	---	MEAN
ST.D.	---	140	208	299	---	---	---	---	---	---	---	---	ST.D.
MAX	---	514	783	1101	---	---	---	---	---	---	---	---	MAX
MIN	---	7.20	0	0	---	---	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	6.05	9.22	13.0	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
Incomplete total.

TOTAL DISCHARGE FOR YEAR, 4259
DRAINAGE AREA (hectares), 8.5

/charge/4100./data/loadsmicro/kcb2.flow92.out Wed Dec 9 19:18:47 1992

TOTAL DAILY DISCHARGE FOR 1992 Kettle Control Microbasin 2 (KCB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	0	0	0	0	---	---	---	---	---	---	1
2	---	---	0	0	0	0	---	---	---	---	---	---	2
3	---	---	18.7	0	0	0	---	---	---	---	---	---	3
4	---	---	4.32	0	0	0	---	---	---	---	---	---	4
5	---	---	4.32	0	0	0	---	---	---	---	---	---	5
6	---	---	156	0	0	0	---	---	---	---	---	---	6
7	---	---	412	0	0	0	---	---	---	---	---	---	7
8	---	---	97.2	0	0	0	---	---	---	---	---	---	8
9	---	---	0	0	0	0	---	---	---	---	---	---	9
10	---	---	96.8	0	0	0	---	---	---	---	---	---	10
11	---	---	0	0	0	0	---	---	---	---	---	---	11
12	---	---	0	0	0	0	---	---	---	---	---	---	12
13	---	---	0	0	0	0	---	---	---	---	---	---	13
14	---	---	0	0	0	0	---	---	---	---	---	---	14
15	---	---	0	0	0	0	---	---	---	---	---	---	15
16	---	---	0	422	0	0	---	---	---	---	---	---	16
17	---	1.80	7.56	0.360	0	0	---	---	---	---	---	---	17
18	---	592	28.4	0	0	0	---	---	---	---	---	---	18
19	---	596	27.7	0	0	0	---	---	---	---	---	---	19
20	---	147	0	0	0	0	---	---	---	---	---	---	20
21	---	98.6	0	19.4	0	0	---	---	---	---	---	---	21
22	---	109	0	2.88	0	0	---	---	---	---	---	---	22
23	---	150	0	10.4	0	0	---	---	---	---	---	---	23
24	---	101	0	1457	0	0	---	---	---	---	---	---	24
25	---	0	19.1	63.0	0	0	---	---	---	---	---	---	25
26	---	0	5.76	18.7	0	0	---	---	---	---	---	---	26
27	---	---	0	0	0	0	---	---	---	---	---	---	27
28	---	149	0	0	0	0	---	---	---	---	---	---	28
29	---	87.8	0	0	0	0	---	---	---	---	---	---	29
30	---		0	0	0	0	---	---	---	---	---	---	30
31	---		0		0		---	---		---		---	31
TOTAL	---	2036#	879	1994	0	0	---	---	---	---	---	---	TOTAL
MEAN	---	169	28.4	66.5	0	0	---	---	---	---	---	---	MEAN
ST.D.	---	206	79.8	273	0	0	---	---	---	---	---	---	ST.D.
MAX	---	596	412	1457	0	0	---	---	---	---	---	---	MAX
MIN	---	0	0	0	0	0	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	14.6	10.1	35.5	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 4910
DRAINAGE AREA (hectares), 4.1

PITTOCK MICROBASIN TOTAL DAILY RUNOFF

/charge/4100./data/loadsmicro/ptb1.flow90.out Wed Dec 9 11:28:19 1992

TOTAL DAILY DISCHARGE FOR 1990 Pittock Test Microbasin 1 (PTB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0	0	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	0	0	0	0	0	3
4	0	0	0	0	0	0	0	0	0	0	0	0	4
5	0	0	0	0	0	0	0	0	0	0	46.4	0	5
6	0	0	0	0	0	0	0	0	0	0	0	0	6
7	0	0	0	0	0	0	0	0	0	0	0	0	7
8	0	0	0	0	0	0	0	0	0	0	0	0	8
9	0	0	501	0	0	0	0	0	0	0	0	0	9
10	0	0	0	0	0	0	0	0	0	0	0	0	10
11	0	0	0	0	0	0	0	0	0	0	0	0	11
12	0	0	0	0	0	0	0	0	0	0	0	0	12
13	0	0	0	0	0	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	0	0	0	0	0	15
16	0	0	0	0	0	0	0	0	0	0	0	0	16
17	0	0	0	0	0	0	0	0	0	0	0	0	17
18	0	0	0	0	0	0	0	0	0	0	0	0	18
19	0	0	0	0	0	0	0	0	0	0	0	0	19
20	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	0	0	0	0	0	0	0	0	0	0	0	21
22	0	1531	0	0	0	0	0	0	0	0	0	0	22
23	0	0	0	0	0	0	0	0	0	0	0	0	23
24	386	0	0	0	0	0	0	0	0	0	0	0	24
25	413	0	0	0	0	0	0	0	0	0	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	0	0	0	0	0	0	0	0	0	0	27
28	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0		0	0	0	0	0	0	0	0	0	0	29
30	0		0	0	0	0	0	0	0	0	0	0	30
31	0		0		0		0	0		0		0	31
TOTAL	799	1531	501	0	0	0	0	0	0	0	46.4	0	TOTAL
MEAN	25.8	54.7	16.2	0	0	0	0	0	0	0	1.55	0	MEAN
ST.D.	99.9	289	90.0	0	0	0	0	0	0	0	8.48	0	ST.D.
MAX	413	1531	501	0	0	0	0	0	0	0	46.4	0	MAX
MIN	0	0	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	1.67	6.18	2.02	---	---	---	---	---	---	---	0.187	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 2879
DRAINAGE AREA (hectares), 24.8

/charge/4100./data/loadsmicro/ptb2.flow90.out Wed Dec 9 14:44:55 1992

TOTAL DAILY DISCHARGE FOR 1990 Pittock Test Microbasin 2 (PTB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0	0	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	0	0	0	0	0	3
4	0	0	0	0	0	0	0	0	0	6.48	0	0	4
5	0	0	0	0	0	0	0	0	0	0	1551	0	5
6	0	0	0	0	0	0	0	0	0	0	2760	0	6
7	0	0	0	0	0	0	0	0	0	0	313	0	7
8	0	718	0	0	0	0	0	0	0	0	0	0	8
9	0	2586	0	0	0	0	126	0	0	1757	0	0	9
10	0	667	965	0	0	0	0	0	0	977	0	0	10
11	0	0	1558	0	0	0	0	0	0	1323	0	0	11
12	0	0	970	0	0	0	0	0	0	326	0	0	12
13	0	0	1803	0	0	0	0	0	0	38.2	0	0	13
14	0	0	1443	0	0	0	0	0	0	0	0	0	14
15	0	0	524	0	0	0	0	0	0	0	0	0	15
16	0	0	80.6	0	0	0	0	0	0	0	0	0	16
17	1396	0	0	0	123	0	0	0	0	0	0	0	17
18	2716	0	0	0	0	0	0	0	0	2093	0	0	18
19	207	0	0	0	0	0	0	0	0	29.2	0	0	19
20	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	0	0	0	0	0	0	0	0	0	0	0	21
22	0	1403	179	0	0	0	0	0	0	0	791	0	22
23	0	2359	287	0	0	0	0	0	0	0	0	0	23
24	0	797	0	0	0	0	0	0	0	0	0	0	24
25	452	0	0	0	0	0	0	0	0	0	0	0	25
26	3.60	0	0	0	0	0	0	0	0	0	0	0	26
27	6.12	0	0	0	0	0	0	0	0	0	0	0	27
28	208	0	0	0	0	0	0	0	0	0	518	0	28
29	0		0	0	0	0	0	0	0	0	0	0	29
30	0		0	0	0	0	0	0	0	0	0	0	30
31	0		0		0		0	0		0		0	31
TOTAL	4991	8533	7815	0	123	0	126	0	0	6551	5935	0	TOTAL
MEAN	161	304	252	0	3.98	0	4.06	0	0	211	197	0	MEAN
ST.D.	542	699	518	0	22.2	0	22.6	0	0	544	582	0	ST.D.
MAX	2716	2586	1803	0	123	0	126	0	0	2093	2760	0	MAX
MIN	0	0	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	9.70	9.24	6.44	---	0.441	---	0.450	---	---	7.48	9.86	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 34076
DRAINAGE AREA (hectares), 28.0

/charge/4100./data/loadsmicro/pcb1.flow90.out Wed Dec 9 11:28:03 1992

TOTAL DAILY DISCHARGE FOR 1990 Pittock Control Microbasin 1 (PCB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0	0	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	0	0	0	0	0	3
4	0	0	0	0	0	0	0	0	0	0	0	0	4
5	0	0	0	0	0	0	0	0	0	0	18.7	0	5
6	0	0	0	0	0	0	0	0	0	0	0	0	6
7	0	0	0	0	0	0	0	0	0	0	0	0	7
8	0	0	0	0	0	0	0	0	0	0	0	0	8
9	0	2.52	4.32	0	0	0	0	0	0	0	0	0	9
10	0	0	0	0	0	0	0	0	0	0	0	0	10
11	0	0	0	0	0	0	0	0	0	0	0	0	11
12	0	0	7.20	0	0	0	0	0	0	0	0	0	12
13	0	0	0	0	0	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	0	0	0	0	0	15
16	0	0	0	0	0	0	0	0	0	0	0	0	16
17	2701	0	0	0	0	0	0	0	0	0	0	0	17
18	0	0	0	0	0	0	0	0	0	0	0	0	18
19	0	0	0	0	0	0	0	0	0	0	0	0	19
20	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	0	0	0	0	0	0	0	0	0	0	0	21
22	0	592	0	0	0	0	0	0	0	0	0	0	22
23	0	0	0	0	0	0	0	0	0	0	0	0	23
24	24.1	0	0	0	0	0	0	0	0	0	0	0	24
25	2.52	0	0	0	0	0	0	0	0	0	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	0	0	0	0	0	0	0	0	0	1.80	27
28	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0		0	0	0	0	0	0	0	0	0	0	29
30	0		0	0	0	0	0	0	0	0	0	0	30
31	0		0		0		0	0		0		0	31
TOTAL	2728	595	11.5	0	0	0	0	0	0	0	18.7	1.80	TOTAL
MEAN	88.0	21.3	0.372	0	0	0	0	0	0	0	0.624	0.0581	MEAN
ST.D.	485	112	1.49	0	0	0	0	0	0	0	3.42	0.323	ST.D.
MAX	2701	592	7.20	0	0	0	0	0	0	0	18.7	1.80	MAX
MIN	0	0	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	21.1	4.63	0.0562	---	---	---	---	---	---	---	0.146	0.0141	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 3355
DRAINAGE AREA (hectares), 12.8

/charge/4100./data/loadsmicro/pcb2.flow90.out Wed Dec 9 11:28:11 1992

TOTAL DAILY DISCHARGE FOR 1990 Pittock Control Microbasin 2 (PCB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0	0	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	0	0	0	0	0	3
4	0	0	0	0	0	0	0	0	0	0	0	0	4
5	0	0	0	0	0	0	0	0	0	0	155	0	5
6	0	0	0	0	0	0	0	0	0	0	10.1	0	6
7	0	0	0	0	0	0	0	0	0	0	0	0	7
8	0	0	0	0	0	0	0	0	0	0	0	0	8
9	0	0	0	0	0	0	0	0	0	0	0	0	9
10	0	0	0	0	0	0	0	0	0	0	0	0	10
11	0	0	0	0	0	0	0	0	0	0	10.4	0	11
12	0	0	33.1	0	0	0	0	0	0	514	0	0	12
13	0	0	0	0	0	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	0	0	0	0	0	15
16	0	0	0	0	0	0	0	0	0	0	0	0	16
17	0	0	0	0	0	0	0	0	0	0	0	0	17
18	0	0	0	0	0	0	0	0	0	0	0	0	18
19	0	0	0	0	0	0	0	0	0	0	0	0	19
20	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	0	0	0	0	0	0	0	0	0	0	0	21
22	0	36.4	0	0	0	0	0	0	0	0	0	0	22
23	0	0	0	0	0	0	0	0	0	0	0	0	23
24	0	0	0	0	0	0	0	0	0	0	0	0	24
25	0	0	0	0	0	0	0	0	0	0	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	0	0	0	0	0	0	0	0	0	0	27
28	0	0	0	0	0	0	0	0	0	0	0	0	28
29	0		0	0	0	0	0	0	0	0	0	0	29
30	0		0	0	0	0	0	0	0	0	0	0	30
31	0		0		0		0	0		0		0	31
TOTAL	0	36.4	33.1	0	0	0	0	0	0	514	175	0	TOTAL
MEAN	0	1.30	1.07	0	0	0	0	0	0	16.6	5.86	0	MEAN
ST.D.	0	6.87	5.95	0	0	0	0	0	0	92.4	28.3	0	ST.D.
MAX	0	36.4	33.1	0	0	0	0	0	0	514	155	0	MAX
MIN	0	0	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	0.107	0.0974	---	---	---	---	---	---	1.51	0.456	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 759
DRAINAGE AREA (hectares), 34.0

TOTAL DAILY DISCHARGE FOR 1991 Pittock Test Microbasin 1 (PTB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0	0	0	0	0	0	0	0	0	0	0	1
2	0	0	212	0	0	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	0	0	0	0	0	3
4	0	0	0	0	0	0	0	0	0	0	0	0	4
5	0	0	0	0	0	0	0	0	0	0	0	0	5
6	0	10.1	15.5	0	0	0	0	0	0	0	0	0	6
7	0	0	0	0	0	0	0	0	0	0	0	39.2	7
8	0	0	0	0	0	0	0	0	0	0	0	0	8
9	0	0	0	1.44	0	0	0	0	0	0	0	0	9
10	0	0	0	0	0	0	0	0	0	0	0	0	10
11	0	0	0	0	0	0	0	0	0	0	0	0	11
12	0	0	0	0	0	0	0	0	0	0	0	0	12
13	0	0	0	0	0	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	0	0	0	0	0	15
16	0	0	0	0	0	0	0	0	0	0	0	0	16
17	0	0	0	0	0	0	0	0	0	0	0	0	17
18	0	0	0	0	0	0	0	0	0	0	0	0	18
19	0	18.0	0	0	0	0	0	0	0	0	0	0	19
20	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	0	0	0	0	0	0	0	0	0	0	0	21
22	0	0	0	0	0	0	0	0	0	0	0	0	22
23	0	0	0	0	0	0	0	0	0	0	0	0	23
24	0	0	0	0	0	0	0	0	0	0	0	0	24
25	0	0	0	0	0	0	0	0	0	1.08	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	1957	0	0	0	0	0	0	0	0	0	27
28	0	0	291	0	0	0	0	0	0	0	0	0	28
29	0		0	0	0	0	0	0	0	0	0	0	29
30	0		0	0	0	0	0	0	0	0	0	0	30
31	0		0		0		0	0		0		0	31
TOTAL	0	28.1	2476	1.44	0	0	0	0	0	1.08	0	39.2	TOTAL
MEAN	0	1.00	79.9	0.0480	0	0	0	0	0	0.0348	0	1.27	MEAN
ST.D.	0	3.84	354	0.263	0	0	0	0	0	0.194	0	7.05	ST.D.
MAX	0	18.0	1957	1.44	0	0	0	0	0	1.08	0	39.2	MAX
MIN	0	0	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	0.0726	7.89	0.0058	---	---	---	---	---	0.0044	---	0.158	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 2546
DRAINAGE AREA (hectares), 24.8

TOTAL DAILY DISCHARGE FOR 1991 Pittock Test Microbasin 2 (PTB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		DAY
1	0	0	0	0	0	0	0	0	0	0	0	0		1
2	0	0	1647	0	0	0	0	0	0	0	0	0		2
3	0	0	564	0	0	0	0	0	0	0	0	0		3
4	0	0	0	0	0	0	0	0	0	0	0	0		4
5	0	0	0	0	0	0	0	0	0	0	0	0		5
6	0	0	1345	0	0	0	0	0	0	0	0	0		6
7	0	0	616	0	0	0	0	0	0	0	0	0		7
8	0	0	0	0	0	0	0	0	0	0	0	0		8
9	0	0	0	1108	0	0	0	0	0	0	0	0		9
10	0	0	0	510	0	0	0	0	0	0	0	0		10
11	0	0	0	0	0	0	0	0	0	0	0	0		11
12	0	0	0	0	0	0	0	0	0	0	0	0		12
13	0	0	0	0	0	0	0	0	0	0	0	0		13
14	0	0	0	0	0	0	0	0	0	0	0	0		14
15	0	0	0	1555	0	0	0	0	0	0	0	0		15
16	0	0	0	136	0	0	0	0	0	0	0	0		16
17	0	0	0	0	0	0	0	0	0	0	0	0		17
18	0	0	1594	0	0	0	0	0	0	0	0	0		18
19	0	0	78.5	0	0	0	0	0	0	0	0	0		19
20	0	0	0	1.80	0	0	0	0	0	0	0	---		20
21	0	0	0	61.9	0	0	0	0	0	0	0	---		21
22	0	0	0	0	0	0	0	0	0	0	0	---		22
23	0	0	0	0	0	0	0	0	0	0	0	---		23
24	0	0	262	0	0	0	0	0	0	0	0	---		24
25	0	0	0	0	0	0	0	0	0	0	0	---		25
26	0	0	0	0	0	0	0	0	0	0	0	---		26
27	0	0	2661	0	0	0	0	0	0	0	0	---		27
28	0	0	2133	0	0	0	0	0	0	0	0	---		28
29	0		103	0	0	0	0	0	0	0	0	---		29
30	0		0	0	0	0	0	0	0	0	0	---		30
31	0		0		0		0	0		0		---		31
TOTAL	0	0	11007	3374	0	0	0	0	0	0	0	0	#	TOTAL
MEAN	0	0	355	112	0	0	0	0	0	0	0	0		MEAN
ST.D.	0	0	720	349	0	0	0	0	0	0	0	0		ST.D.
MAX	0	0	2661	1555	0	0	0	0	0	0	0	0		MAX
MIN	0	0	0	0	0	0	0	0	0	0	0	0		MIN
MAX DLY AVG AREA FLOWS	---	---	9.50	5.56	---	---	---	---	---	---	---	---		MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 14381
DRAINAGE AREA (hectares), 28.0

/charge/4100./data/loadsmicro/pcb1.flow91.out Wed Dec 9 14:12:13 1992

TOTAL DAILY DISCHARGE FOR 1991 Pittock Control Microbasin 1 (PCB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		DAY
1	0	0	0	0	0	0	0	0	0	0	0	0		1
2	0	0	0.360	0	0	0	0	0	0	0	0	0		2
3	0	0	0	0	0	0	0	0	0	0	0	0		3
4	0	0	0	0	0	0	0	0	0	0	0	0		4
5	0	0	0	0	0	0	0	0	0	0	0	0		5
6	0	0	11.2	0	0	0	0	0	0	0	0	0		6
7	0	0	0	0	0	0	0	0	0	0	0	0		7
8	0	0	0	0	0	0	0	0	0	0	0	0		8
9	0	0	0	0	0	0	0	0	0	0	0	0		9
10	0	0	0	0	0	0	0	0	0	0	0	0		10
11	0	0	0	0	0	0	0	0	0	0	0	0		11
12	0	0	0	0	0	0	0	0	0	0	0	0		12
13	0	0	0	0	0	0	0	0	0	0	0	0		13
14	0	0	0	0	0	0	0	0	0	0	0	0		14
15	0	0	0	0	0	0	0	0	0	0	0	0		15
16	0	0	0	0	0	0	0	0	0	0	0	0		16
17	0	0	0	0	0	0	0	0	0	0	0	0		17
18	0	0	0	0	0	0	0	0	0	0	0	0		18
19	0	76.7	0	0	0	0	0	0	0	0	0	0		19
20	0	0	0	0	0	0	0	0	0	0	0	---		20
21	0	0	0	0	0	0	0	0	0	0	0	---		21
22	0	0	0	0	0	0	0	0	0	0	0	---		22
23	0	0	0	0	0	0	0	0	0	0	0	---		23
24	0	0	0	0	0	0	0	0	0	0	0	---		24
25	0	0	0	0	0	0	0	0	0	0	0	---		25
26	0	0	0	0	0	0	0	0	0	0	0	---		26
27	0	0	0.360	0	0	0	0	0	0	0	0	---		27
28	0	0	0	0	0	0	0	0	0	0	0	---		28
29	0		0	0	0	0	0	0	0	0	0	---		29
30	0		0	0	0	0	0	0	0	0	0	---		30
31	0		0		0		0	0		0		---		31
TOTAL	0	76.7	11.9	0	0	0	0	0	0	0	0	0	#	TOTAL
MEAN	0	2.74	0.383	0	0	0	0	0	0	0	0	0		MEAN
ST.D.	0	14.5	2.00	0	0	0	0	0	0	0	0	0		ST.D.
MAX	0	76.7	11.2	0	0	0	0	0	0	0	0	0		MAX
MIN	0	0	0	0	0	0	0	0	0	0	0	0		MIN
MAX DLY AVG AREA FLOWS	---	0.599	0.0872	---	---	---	---	---	---	---	---	---		MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 88.6
DRAINAGE AREA (hectares), 12.8

TOTAL DAILY DISCHARGE FOR 1991 Pittock Control Microbasin 2 (PCB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0	0	0	0	0	0	0	0	0	0	0	1
2	0	0	227	0	0	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	0	0	0	0	0	0	3
4	0	0	0	0	0	0	0	0	0	0	0	0	4
5	0	0	0	0	0	0	0	0	0	0	0	0	5
6	0	0	366	0	0	0	0	0	0	0	0	0	6
7	0	0	92.2	0	0	0	0	0	0	0	0	0	7
8	0	0	0	0	0	0	0	0	0	0	0	0	8
9	0	0	0	0	0	0	0	0	0	0	0	0	9
10	0	0	0	0	0	0	0	0	0	0	0	0	10
11	0	0	0	0	0	0	0	0	0	0	0	0	11
12	0	0	0	0	0	0	0	0	0	0	0	0	12
13	0	0	0	0	0	0	0	0	0	0	0	0	13
14	0	0	0	0	0	0	0	0	0	0	0	0	14
15	0	0	0	0	0	0	0	0	0	0	0	0	15
16	0	0	0	0	0	0	0	0	0	0	0	0	16
17	0	0	0	0	0	0	0	0	0	0	0	0	17
18	0	0	0	0	0	0	0	0	0	0	0	0	18
19	0	0	0	0	0	0	0	0	0	0	0	0	19
20	0	0	0	0	0	0	0	0	0	0	0	0	20
21	0	0	0.360	0	0	0	0	0	0	0	0	0	21
22	0	0	0	0	0	0	0	0	0	0	0	0	22
23	0	0	0	0	0	0	0	0	0	0	0	0	23
24	0	0	0	0	0	0	0	0	0	0	0	0	24
25	0	0	0	0	0	0	0	0	0	0	0	0	25
26	0	0	0	0	0	0	0	0	0	0	0	0	26
27	0	0	914	0	0	0	0	0	0	0	0	0	27
28	0	0	961	0	0	0	0	0	0	0	0	0	28
29	0		0	0	0	0	0	0	0	0	0	0	29
30	0		0	0	0	0	0	0	0	0	0	0	30
31	0		0		0		0	0		0		0	31
TOTAL	0	0	2562	0	0	0	0	0	0	0	0	0	TOTAL
MEAN	0	0	82.6	0	0	0	0	0	0	0	0	0	MEAN
ST.D.	0	0	240	0	0	0	0	0	0	0	0	0	ST.D.
MAX	0	0	961	0	0	0	0	0	0	0	0	0	MAX
MIN	0	0	0	0	0	0	0	0	0	0	0	0	MIN
MAX DLY AVG AREA FLOWS	---	---	2.83	---	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 2562
DRAINAGE AREA (hectares),. 34.0

/charge/4100./data/loadsmicro/ptb1.flow92.out Wed Dec 9 19:19:32 1992

TOTAL DAILY DISCHARGE FOR 1992 Pittock Test Microbasin 1 (PTB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0	---	0	0	0	---	---	---	---	---	---	1
2	0	0	---	0	0	0	---	---	---	---	---	---	2
3	0	0	---	0	3.96	0	---	---	---	---	---	---	3
4	0	0	---	0	0	0	---	---	---	---	---	---	4
5	0	0	---	0	0	0	---	---	---	---	---	---	5
6	0	0	0	0	0	0	---	---	---	---	---	---	6
7	0	0	792	0	0	0	---	---	---	---	---	---	7
8	0	0	2900	0	0	0	---	---	---	---	---	---	8
9	0	0	1684	0	0	0	---	---	---	---	---	---	9
10	0	0	2.88	0	0	0	---	---	---	---	---	---	10
11	0	0	5.76	0	0	0	---	---	---	---	---	---	11
12	0	0	0	0	0	0	---	---	---	---	---	---	12
13	0	0	0	0	0	0	---	---	---	---	---	---	13
14	0	0	0	0	0	0	---	---	---	---	---	---	14
15	0	0	0	0	0	0	---	---	---	---	---	---	15
16	0	0	0	0	0	0	---	---	---	---	---	---	16
17	0	0	0	125	0	0	---	---	---	---	---	---	17
18	0	0	0	111	3.24	0	---	---	---	---	---	---	18
19	0	5.40	0	0	0	0	---	---	---	---	---	---	19
20	0	---	0	0	0	0	---	---	---	---	---	---	20
21	0	0	0	0	0	0	---	---	---	---	---	---	21
22	0	---	0	0	0	0	---	---	---	---	---	---	22
23	0	---	0	0	0	0	---	---	---	---	---	---	23
24	0	---	0	0	0	0	---	---	---	---	---	---	24
25	0	---	0	0	0	0	---	---	---	---	---	---	25
26	0	---	0	0	0	0	---	---	---	---	---	---	26
27	0	---	0	0	0	0	---	---	---	---	---	---	27
28	0	---	0	0	0	0	---	---	---	---	---	---	28
29	0	---	0	0	0	0	---	---	---	---	---	---	29
30	0		0	0	0	0	---	---	---	---	---	---	30
31	0		0		0		---	---		---		---	31
TOTAL	0	5.40#	5385#	237	7.20	0	---	---	---	---	---	---	TOTAL
MEAN	0	0.270	207	7.92	0.232	0	---	---	---	---	---	---	MEAN
ST.D.	0	1.21	656	30.2	0.904	0	---	---	---	---	---	---	ST.D.
MAX	0	5.40	2900	125	3.96	0	---	---	---	---	---	---	MAX
MIN	0	0	0	0	0	0	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	0.0218	11.7	0.507	0.0160	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 5636
DRAINAGE AREA (hectares), 24.8

/charge/4100./data/loadsmicro/ptb2.flow92.out Wed Dec 9 19:19:42 1992

TOTAL DAILY DISCHARGE FOR 1992 Pittock Test Microbasin 2 (PTB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	0	0	0	---	---	---	---	---	---	1
2	---	---	---	0	0	0	---	---	---	---	---	---	2
3	---	---	---	0	346	0	---	---	---	---	---	---	3
4	---	---	---	0	59.0	0	---	---	---	---	---	---	4
5	---	---	---	0	0	0	---	---	---	---	---	---	5
6	---	---	775	0	0	0	---	---	---	---	---	---	6
7	---	---	1086	0	0	0	---	---	---	---	---	---	7
8	---	---	370	0	0	0	---	---	---	---	---	---	8
9	---	---	570	0	0	0	---	---	---	---	---	---	9
10	---	---	1326	0	0	0	---	---	---	---	---	---	10
11	---	---	268	0	0	0	---	---	---	---	---	---	11
12	---	---	2.52	0	0	0	---	---	---	---	---	---	12
13	---	---	0	0	0	0	---	---	---	---	---	---	13
14	---	---	0	0	0	0	---	---	---	---	---	---	14
15	---	---	0	0	0	0	---	---	---	---	---	---	15
16	---	---	0	0	0	0	---	---	---	---	---	---	16
17	---	---	0	1078	0	0	---	---	---	---	---	---	17
18	---	---	0	235	0	0	---	---	---	---	---	---	18
19	---	421	0	6.12	0	0	---	---	---	---	---	---	19
20	---	---	0	0	0	0	---	---	---	---	---	---	20
21	---	112	0	0	0	0	---	---	---	---	---	---	21
22	---	---	0	0	0	0	---	---	---	---	---	---	22
23	---	---	0	0	0	0	---	---	---	---	---	---	23
24	---	---	445	0	0	0	---	---	---	---	---	---	24
25	---	---	1241	0	0	0	---	---	---	---	---	---	25
26	---	---	0	0	0	0	---	---	---	---	---	---	26
27	---	---	0	0	0	0	---	---	---	---	---	---	27
28	---	---	0	0	0	0	---	---	---	---	---	---	28
29	---	---	0	0	0	0	---	---	---	---	---	---	29
30	---		0	0	0	0	---	---	---	---	---	---	30
31	---		0		0		---	---		---		---	31
TOTAL	---	534#	6087#	1320	405	0	---	---	---	---	---	---	TOTAL
MEAN	---	267	234	44.0	13.1	0	---	---	---	---	---	---	MEAN
ST.D.	---	218	419	200	62.8	0	---	---	---	---	---	---	ST.D.
MAX	---	421	1326	1078	346	0	---	---	---	---	---	---	MAX
MIN	---	112	0	0	0	0	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	1.51	4.74	3.85	1.24	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 8349
DRAINAGE AREA (hectares), 28.0

TOTAL DAILY DISCHARGE FOR 1992 Pittock Control Microbasin 1 (PCB1)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	0	0	0	---	---	---	---	---	---	1
2	---	---	---	0	0	0	---	---	---	---	---	---	2
3	---	---	---	0	0	0	---	---	---	---	---	---	3
4	---	---	---	0	0	0	---	---	---	---	---	---	4
5	---	---	---	0	0	0	---	---	---	---	---	---	5
6	---	---	---	0	0	0	---	---	---	---	---	---	6
7	---	---	---	0	0	0	---	---	---	---	---	---	7
8	---	---	0	0	0	0	---	---	---	---	---	---	8
9	---	---	0	0	0	0	---	---	---	---	---	---	9
10	---	---	0.360	0	0	0	---	---	---	---	---	---	10
11	---	---	0	0	0	0	---	---	---	---	---	---	11
12	---	---	0	0	0	0	---	---	---	---	---	---	12
13	---	---	0	0	0	0	---	---	---	---	---	---	13
14	---	---	0	0	0	0	---	---	---	---	---	---	14
15	---	---	0	0	0	0	---	---	---	---	---	---	15
16	---	---	0	5.04	0	0	---	---	---	---	---	---	16
17	---	---	0	0	0	0	---	---	---	---	---	---	17
18	---	---	0	0	0	0	---	---	---	---	---	---	18
19	---	---	0	0	0	0	---	---	---	---	---	---	19
20	---	---	0	0	0	0	---	---	---	---	---	---	20
21	---	---	0	0	0	0	---	---	---	---	---	---	21
22	---	---	0	0	0	0	---	---	---	---	---	---	22
23	---	---	0	0	0	0	---	---	---	---	---	---	23
24	---	---	0	0	0	0	---	---	---	---	---	---	24
25	---	---	0	0	0	0	---	---	---	---	---	---	25
26	---	---	0	0	0	0	---	---	---	---	---	---	26
27	---	---	0	0	0	0	---	---	---	---	---	---	27
28	---	---	0	0	0	0	---	---	---	---	---	---	28
29	---	---	0	0	0	0	---	---	---	---	---	---	29
30	---		0	0	0	0	---	---	---	---	---	---	30
31	---		0		0		---	---		---		---	31
TOTAL	---	---	0.360#	5.04	0	0	---	---	---	---	---	---	TOTAL
MEAN	---	---	0.0150	0.168	0	0	---	---	---	---	---	---	MEAN
ST.D.	---	---	0.0735	0.920	0	0	---	---	---	---	---	---	ST.D.
MAX	---	---	0.360	5.04	0	0	---	---	---	---	---	---	MAX
MIN	---	---	0	0	0	0	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	---	0.0028	0.0394	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 5.40
DRAINAGE AREA (hectares), 12.8

TOTAL DAILY DISCHARGE FOR 1992 Pittock Control Microbasin 2 (PCB2)

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0	0	---	0	0	0	---	---	---	---	---	---	1
2	0	63.0	---	0	0	0	---	---	---	---	---	---	2
3	0	0	---	0	0	0	---	---	---	---	---	---	3
4	0	1.08	---	0	0	0	---	---	---	---	---	---	4
5	0	0	---	0	0	0	---	---	---	---	---	---	5
6	0	136	---	0	0	0	---	---	---	---	---	---	6
7	0	424	---	0	0	0	---	---	---	---	---	---	7
8	0	57.6	0	0	0	0	---	---	---	---	---	---	8
9	0	0	0	0	0	0	---	---	---	---	---	---	9
10	0	0	2850	0	0	0	---	---	---	---	---	---	10
11	0	0	0	0	0	0	---	---	---	---	---	---	11
12	0	0	0	0	0	0	---	---	---	---	---	---	12
13	0	0	0	0	0	0	---	---	---	---	---	---	13
14	0	0	0	0	0	0	---	---	---	---	---	---	14
15	0	0	0	0	0	0	---	---	---	---	---	---	15
16	0	0	0	0	0	0	---	---	---	---	---	---	16
17	0	0	0	14.4	0	0	---	---	---	---	---	---	17
18	0	0	0	0	0	0	---	---	---	---	---	---	18
19	0	0	0	0	0	0	---	---	---	---	---	---	19
20	0	0	0	0	0	0	---	---	---	---	---	---	20
21	0	0	0	0	0	0	---	---	---	---	---	---	21
22	0	0	0	0	0	0	---	---	---	---	---	---	22
23	0	0	0	0	0	0	---	---	---	---	---	---	23
24	0	0	0	0	0	0	---	---	---	---	---	---	24
25	0	0	0	0	0	0	---	---	---	---	---	---	25
26	0	0	0	0	0	0	---	---	---	---	---	---	26
27	0	0	0	0	0	0	---	---	---	---	---	---	27
28	0	---	0	0	0	0	---	---	---	---	---	---	28
29	0	---	0	0	0	0	---	---	---	---	---	---	29
30	0		0	0	0	0	---	---	---	---	---	---	30
31	0		0		0		---	---		---		---	31
TOTAL	0	681#	2850#	14.4	0	0	---	---	---	---	---	---	TOTAL
MEAN	0	25.3	118	0.480	0	0	---	---	---	---	---	---	MEAN
ST.D.	0	85.1	581	2.63	0	0	---	---	---	---	---	---	ST.D.
MAX	0	424	2850	14.4	0	0	---	---	---	---	---	---	MAX
MIN	0	0	0	0	0	0	---	---	---	---	---	---	MIN
MAX DLY AVG AREA FLOWS	---	1.25	8.38	0.0424	---	---	---	---	---	---	---	---	MAX DLY AVG AREA FLOWS

NOTE: discharge given in m^3/d , area flows given in l/m^2
incomplete total.

TOTAL DISCHARGE FOR YEAR, 3546
DRAINAGE AREA (hectares), 34.0

APPENDIX C

RAINFALL SIMULATION DATA

Characteristics of Rainfall Simulation Sites

Season	Watershed	Plot ID	slope (%)	antecedent moisture (%)	residue (%)
PT90	Essex	et1	3	19.11	59
		et2	3.25	17.64	59
		et3	1	18.96	74
		ec1	4	19.49	6
		ec2	6.75	18.9	5
		ec3	5	17.29	3
	Kettle Creek	kt1	7	33	76
		kt2	6.25	35.83	79
		kt3	6.25	33.45	85
		kc1	9.27	29.36	2
		kc2	12.03	32.79	3
		kc3	13	30.94	4
	Pittock	pt1	11.55	37.24	11
		pt2	15.7	37.21	13
		pt3	12.35	37.38	7
		pc1	8.85	38.33	4
		pc2	9.5	34.09	2
		pc3	3.2	25.36	3
PP91	Essex	et1	1.8	29.64	84
		et2	1.4	27.51	94
		et3	0.65	25.64	91
		ec1	5	18.75	15
		ec2	4.15	10.82	12
		ec3	3.33	17.07	4
	Kettle Creek	kt1	5.25	27.72	84
		kt2	7.35	28.62	81
		kt3	6.65	29.49	84
		kc1	5.7	25.85	6
		kc2	7.35	29.91	8
		kc3	7.2	28.08	15
	Pittock	pt1	3.5	29.47	37
		pt2	6.7	29.12	34
		pt3	2.4	27.18	44
		pc1	0.65	16.32	11
		pc2	4	15.03	13
		pc3	4.3	16.67	12

Characteristics of Rainfall Simulation Sites

Season	Watershed	Plot ID	slope (%)	antecedent moisture (%)	residue (%)
PH91	Essex	et1	2.05	15.93	47
		et2	1.2	16.78	54
		et3	2.8	16.9	60
		ec1	4.9	15.18	65
		ec2	4.3	15.93	71
		ec3	1.9	15.25	65
	Kettle Creek	kt1	4.8	15.35	95
		kt2	2.6	16.29	88
		kt3	2.4	16.52	90
		kc1	6	7.39	88
		kc2	5.3	8.69	80
		kc3	5.2	10.45	81
	Pittock	pt1	2.4	34.14	92
		pt2	3.1	35.1	87
		pt3	2.2	35.87	90
		pc1	1.3	19.76	91
		pc2	0.8	18.52	85
		pc3	1.5	19.6	78
PT91	Essex	et1	1.05	17.35	48
		et2	1.1	16.72	43
		et3	1.75	12.78	26
		ec1	2.85	17.44	43
		ec2	2	14.06	34
		ec3	1.55	13.26	32
	Kettle Creek	kt1	4.8	15.35	95
		kt2	2.6	16.29	88
		kt3	2.4	16.52	90
		kc1	7	23.13	8
		kc2	7.9	23.44	4
		kc3	3.9	25.17	13
	Pittock	pt1	2.4	34.14	92
		pt2	3.1	35.1	87
		pt3	2.2	35.87	90
		pc1	7.05	33.49	2
		pc2	9.1	33.67	6
		pc3	10.5	35.18	1

Characteristics of Rainfall Simulation Sites

Season	Watershed	Plot ID	slope (%)	antecedent moisture (%)	residue (%)
PP92	Essex	et1	1.5	20.37	53
		et2	2.25	24.17	65
		et3	1	20.97	33
		ec1	5.4	22.51	4
		ec2	4.5	27.52	5
		ec3	5.4	23.33	5
	Kettle Creek	kt1	3.1	21.4	92
		kt2	1.35	24.9	94
		kt3	3.7	22.8	92
		kc1	3.1	24.1	31
		kc2	1.8	26.17	30
		kc3	4	26.29	28
	Pittock	pt1	1.7	29.62	78
		pt2	1.2	30.11	71
		pt3	2.6	29.62	92
		pc1	5.4	21.97	17
		pc2	3	22.84	12
		pc3	1.2	23.38	20

Hydrological Parameters Measured on Rainfall Simulation Sites

Season	Watershed	Plot ID	Time to Ponding (sec)	Time to Runoff (sec)	Runoff Volume (ml)
PT90	Essex	et1	40	135	6250
		et2	42	205	1050
		et3	90	230	1080
		ec1	95	170	5000
		ec2	105	480	500
		ec3	90	300	1500
	Kettle Creek	kt1	5	20	25750
		kt2	12	35	19050
		kt3	10	37	19500
		kc1	10	75	250
		kc2	15	150	300
		kc3	18	80	12800
	Pittock	pt1	32	0	0
		pt2	5	120	5500
		pt3	25	120	2550
		pc1	7	160	250
		pc2	10	140	250
		pc3	15	160	400
PP91	Essex	et1	75	180	5950
		et2	75	295	3600
		et3	55	300	6000
		ec1	30	110	14450
		ec2	34	135	8400
		ec3	24	90	16500
	Kettle Creek	kt1	15	55	18700
		kt2	12	60	26750
		kt3	12	58	23500
		kc1	7	600	600
		kc2	10	200	250
		kc3	6	240	500
	Pittock	pt1	12	235	10100
		pt2	15	90	1500
		pt3	20	85	250
		pc1	25	180	2000
		pc2	20	105	3600
		pc3	13	150	1750

Hydrological Parameters Measured on Rainfall Simulation Sites

Season	Watershed	Plot ID	Time to Ponding (sec)	Time to Runoff (sec)	Runoff Volume (ml)
PH91	Essex	et1	41	180	8450
		et2	25	510	0
		et3	30	180	9600
		ec1	55	180	2750
		ec2	40	135	4700
		ec3	45	345	1400
	Kettle Creek	kt1	45	250	500
		kt2	45	500	3500
		kt3	55	500	250
		kc1	90	170	3750
		kc2	52	238	1750
		kc3	46	192	5000
	Pittock	pt1	28	175	3800
		pt2	30	60	14950
		pt3	35	180	5800
		pc1	46	195	2800
		pc2	55	375	300
		pc3	46	395	5000
PT91	Essex	et1	47	0	0
		et2	125	0	0
		et3	65	895	0
		ec1	120	505	32
		ec2	45	450	2850
		ec3	45	310	5000
	Kettle Creek	kt1	45	250	500
		kt2	45	500	3500
		kt3	55	500	250
		kc1	22	102	250
		kc2	23	480	100
		kc3	18	135	1500
	Pittock	pt1	28	175	3800
		pt2	30	60	14950
		pt3	35	180	5800
		pc1	20	0	0
		pc2	40	0	0
		pc3	50	0	0

Hydrological Parameters Measured on Rainfall Simulation Sites

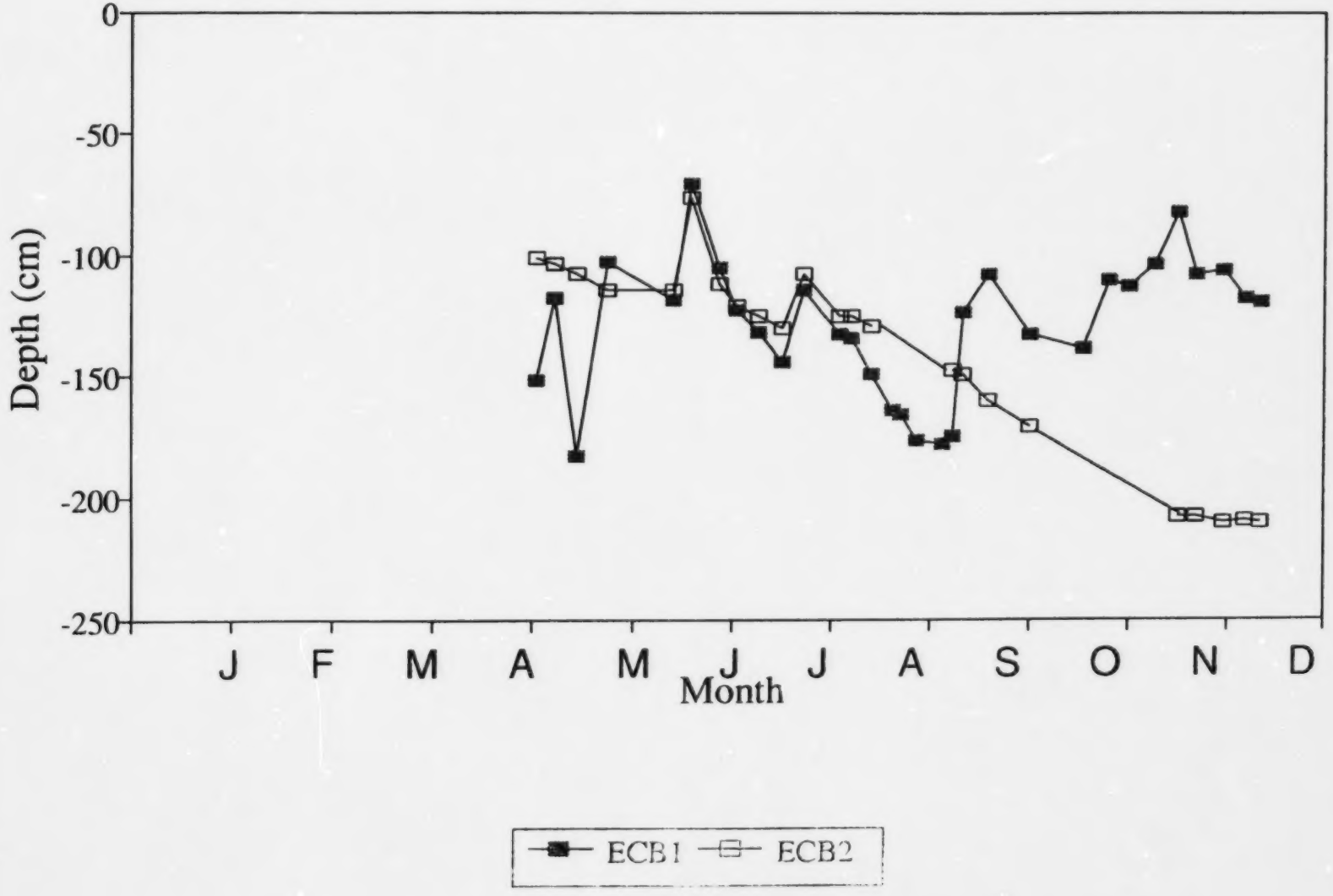
Season	Watershed	Plot ID	Time to Ponding (sec)	Time to Runoff (sec)	Runoff Volume (ml)
PP92	Essex	et1	210	210	9250
		et2	330	240	6500
		et3	330	420	3750
		ec1	210	270	4250
		ec2	150	165	12800
		ec3	120	270	5000
	Kettle Creek	kt1	60	195	11000
		kt2	120	210	8250
		kt3	90	120	15250
		kc1	180	270	6500
		kc2	210	210	8750
		kc3	180	75	12500
	Pittock	pt1	105	120	9250
		pt2	90	165	1750
		pt3	180	150	7500
		pc1	150	120	3500
		pc2	120	165	5500
		pc3	120	150	9250

APPENDIX D

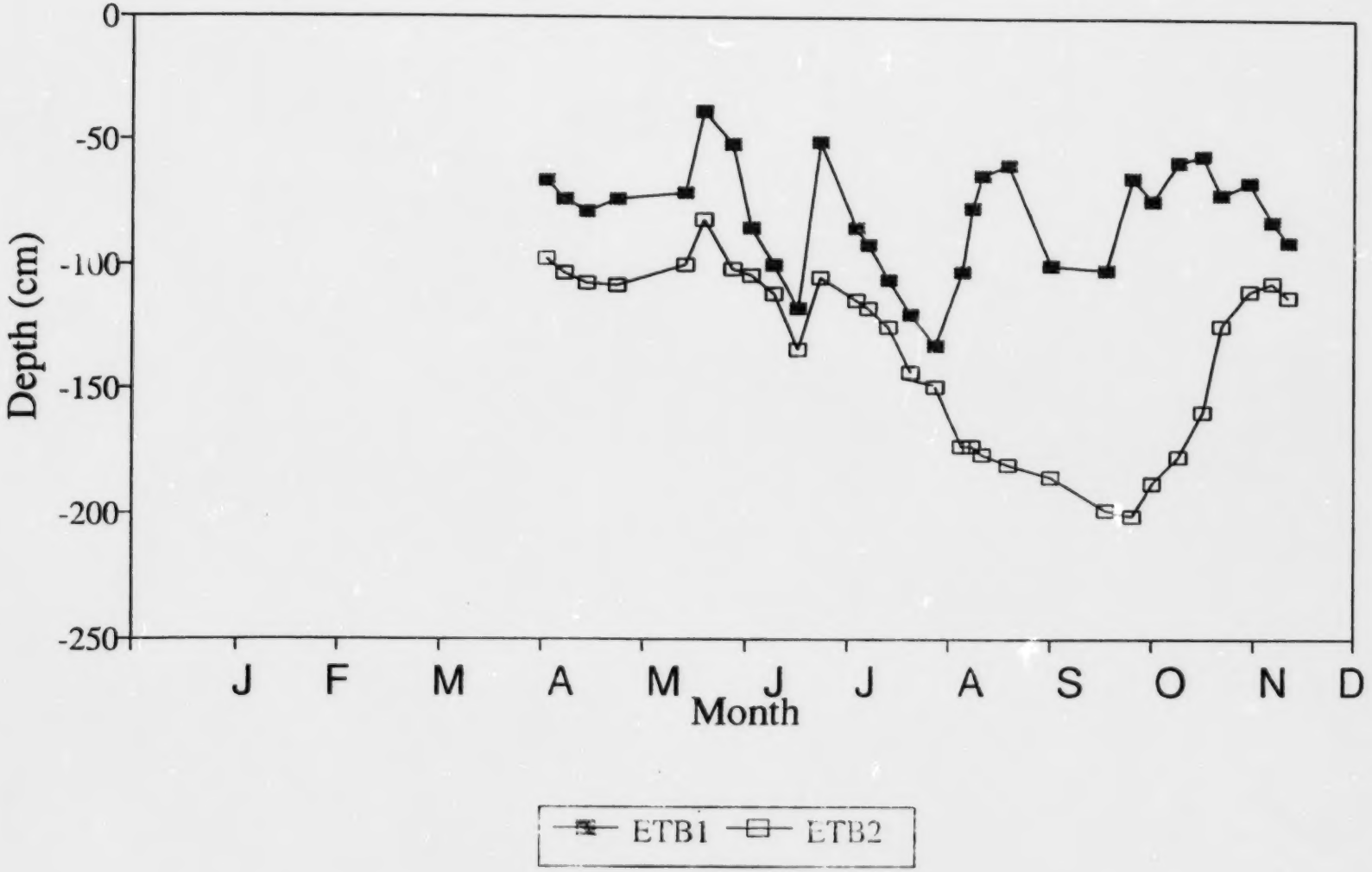
GROUNDWATER AND SOIL MOISTURE

PIEZOMETER WATER LEVELS

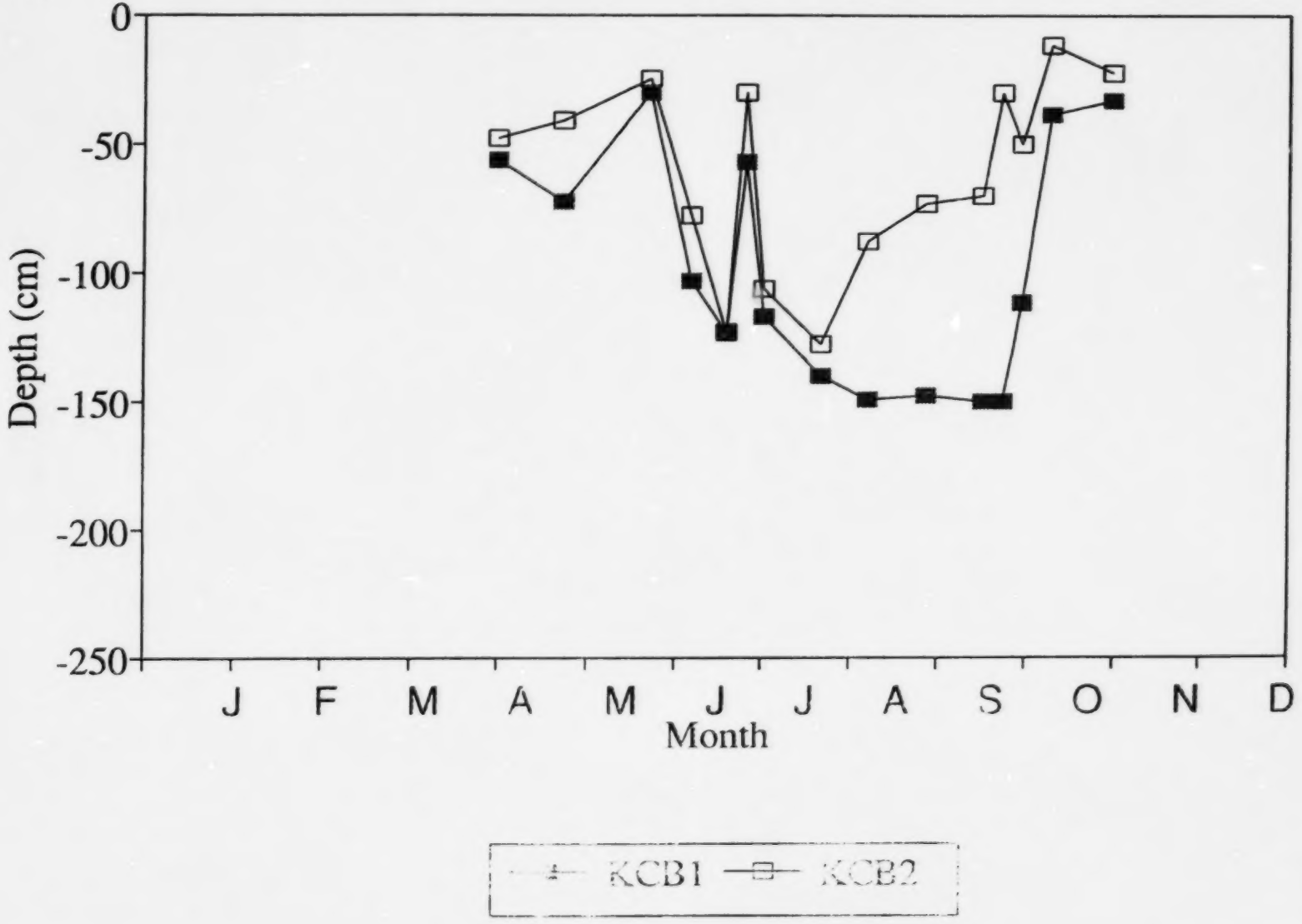
Essex Control Piezometer Data-1989
Depth to Groundwater in ECB1 and ECB2



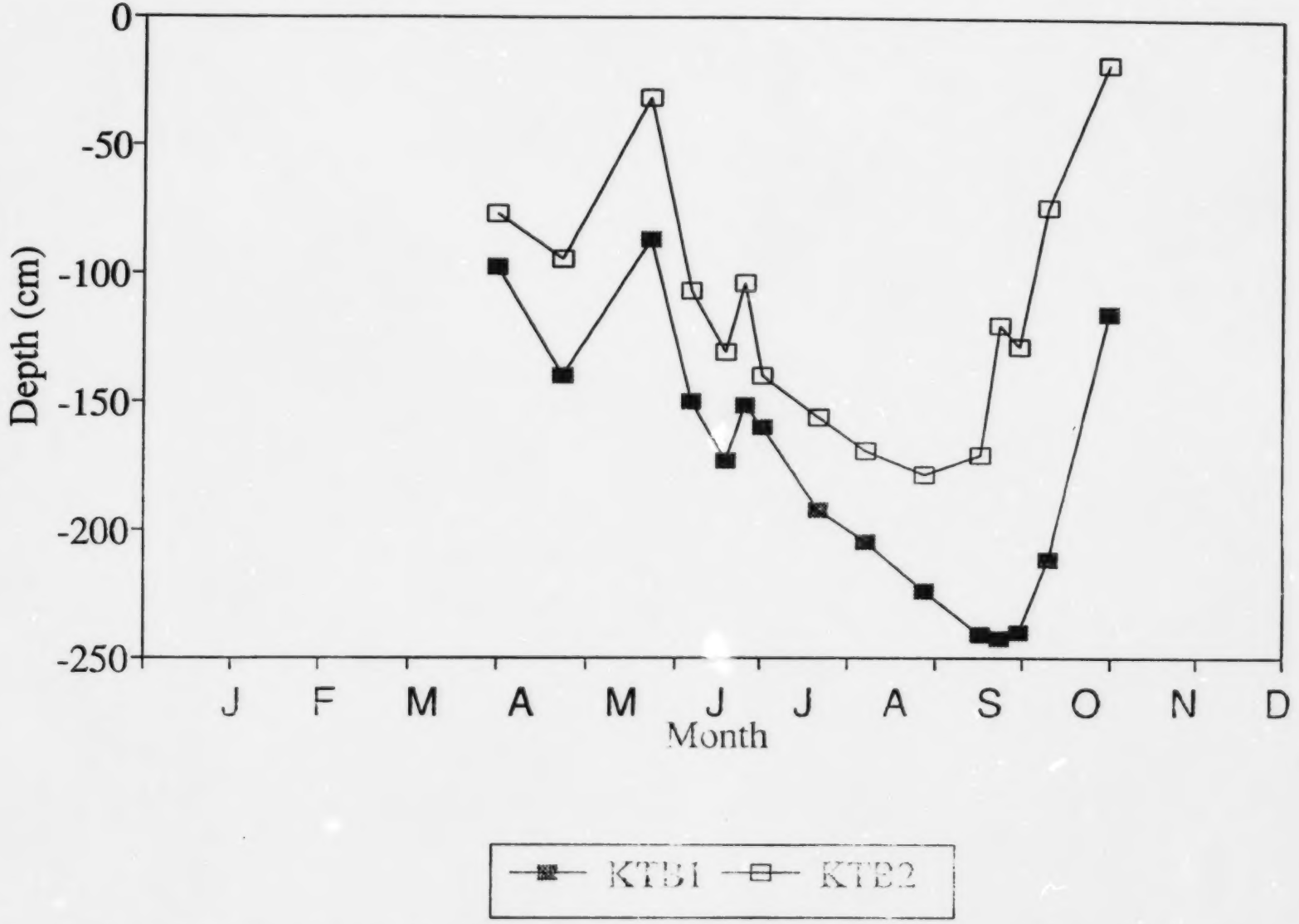
Essex Test Piezometer Data-1989
Depth to Groundwater in ETB1 and ETB2



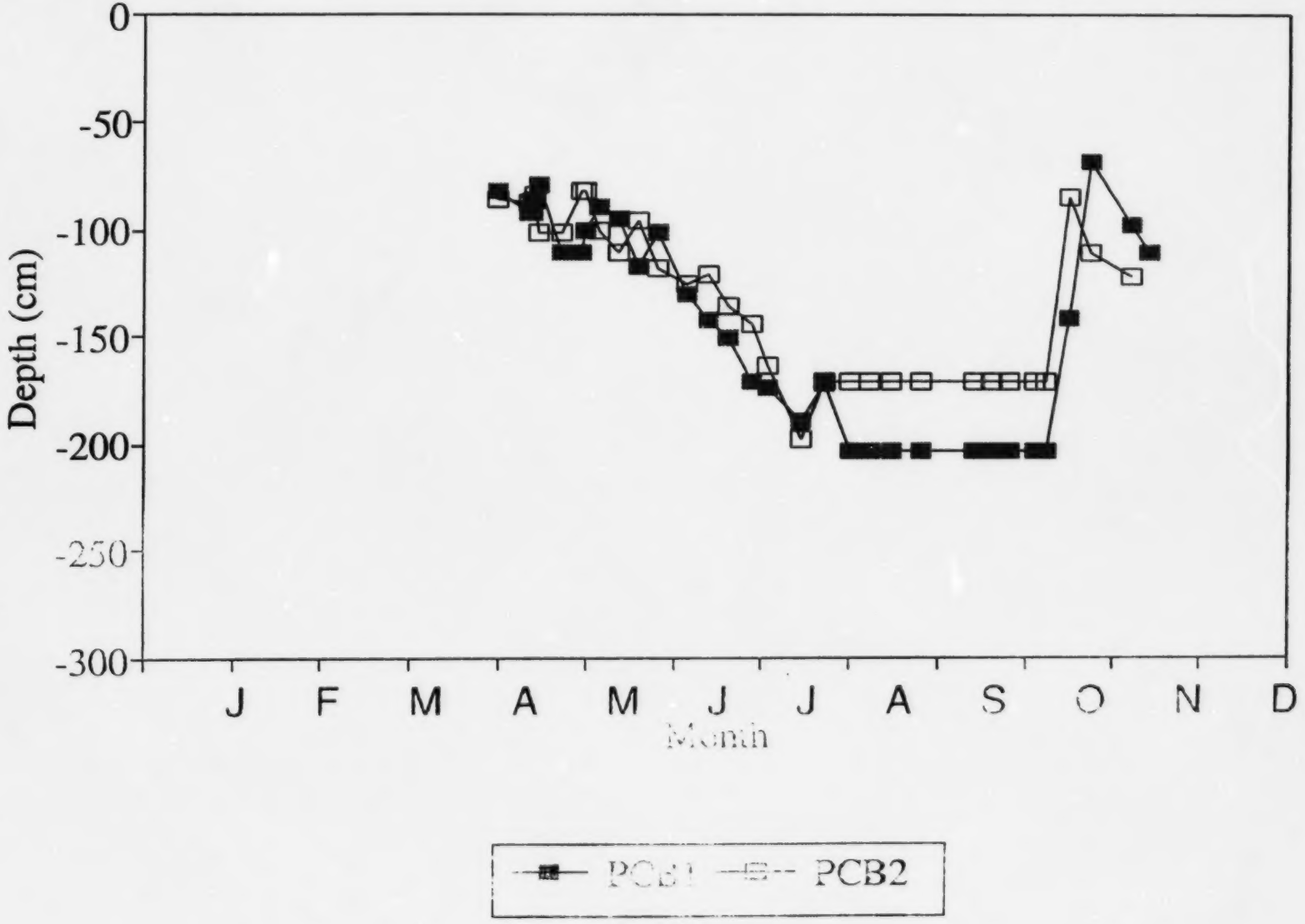
Kettle Cr. Control Piezometer Data-1989
Depth to Groundwater in KCB1 and KCB2



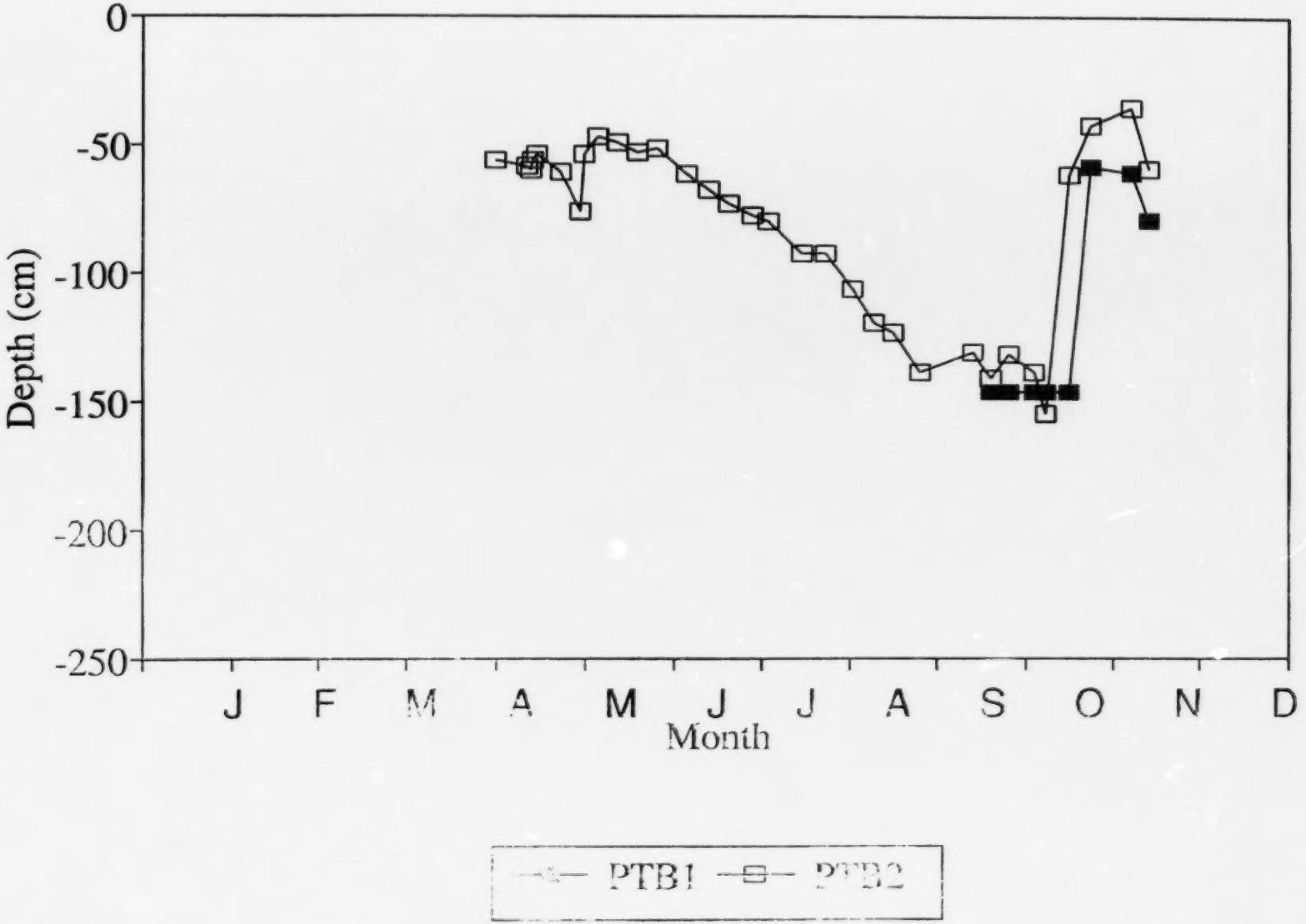
Kettle Cr. Test Piezometer Data-1989
Depth to Groundwater in KTB1 and KTB2



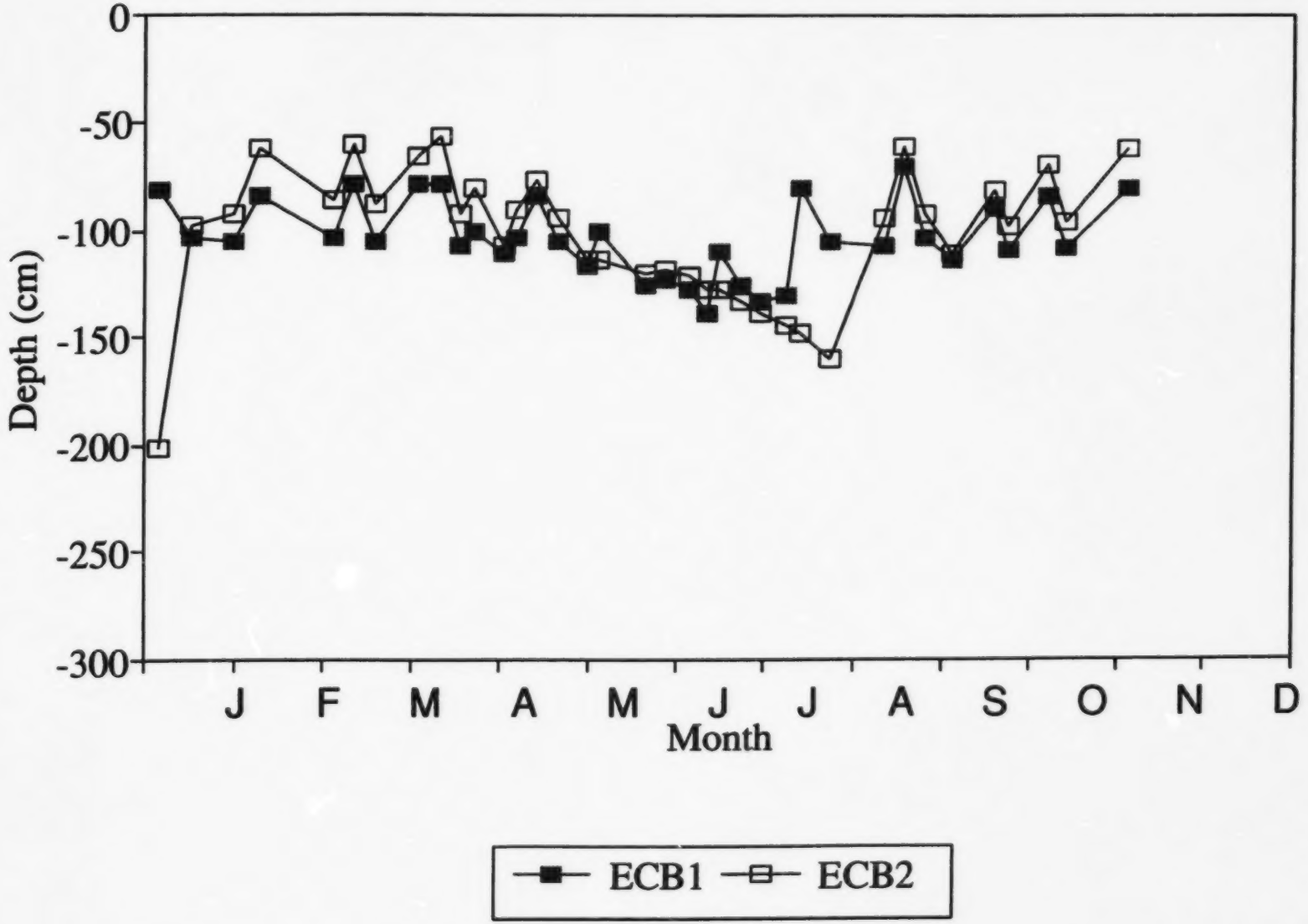
Pittock Control Piezometer Data-1989
Depth to Groundwater in PCB1 and PCB2

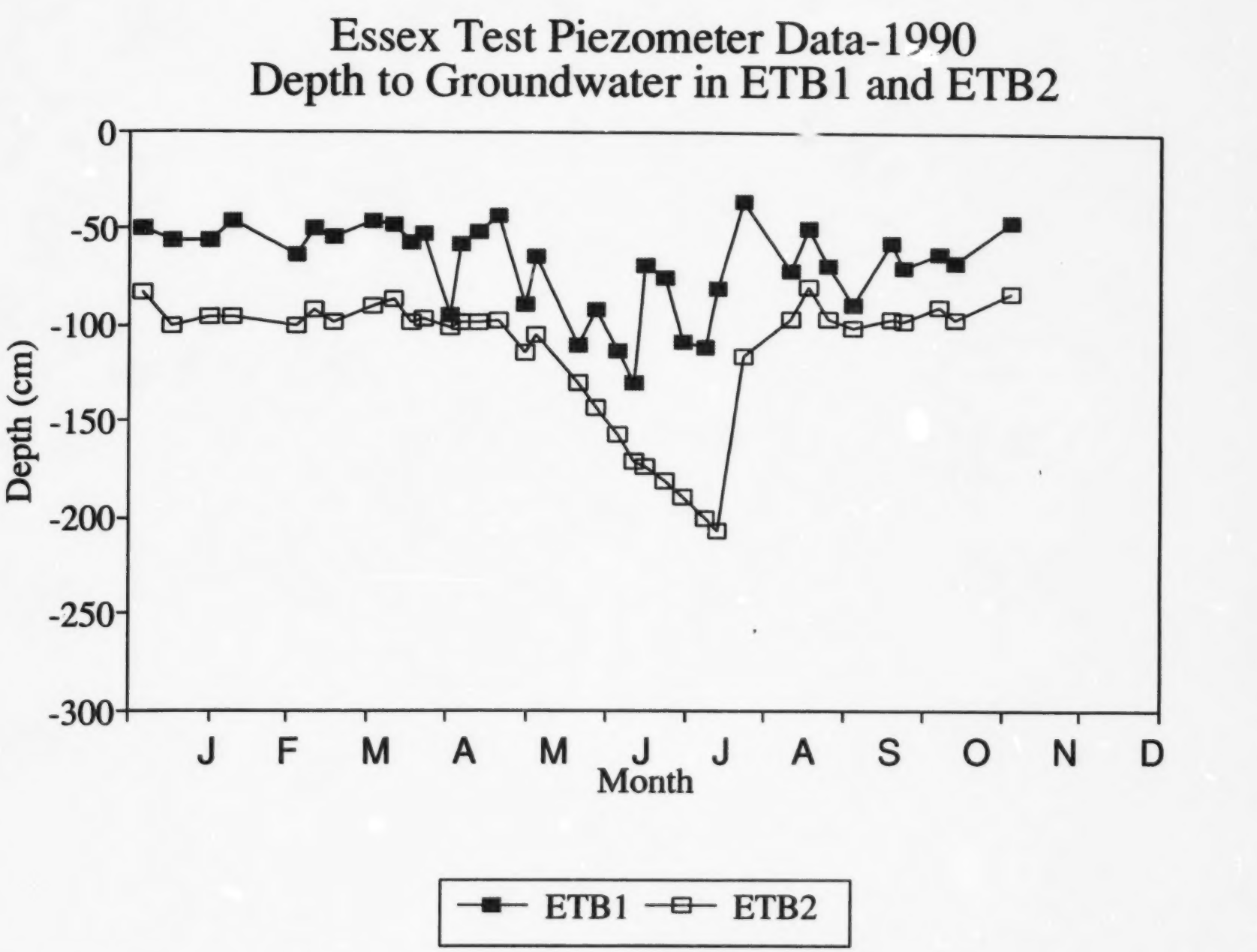


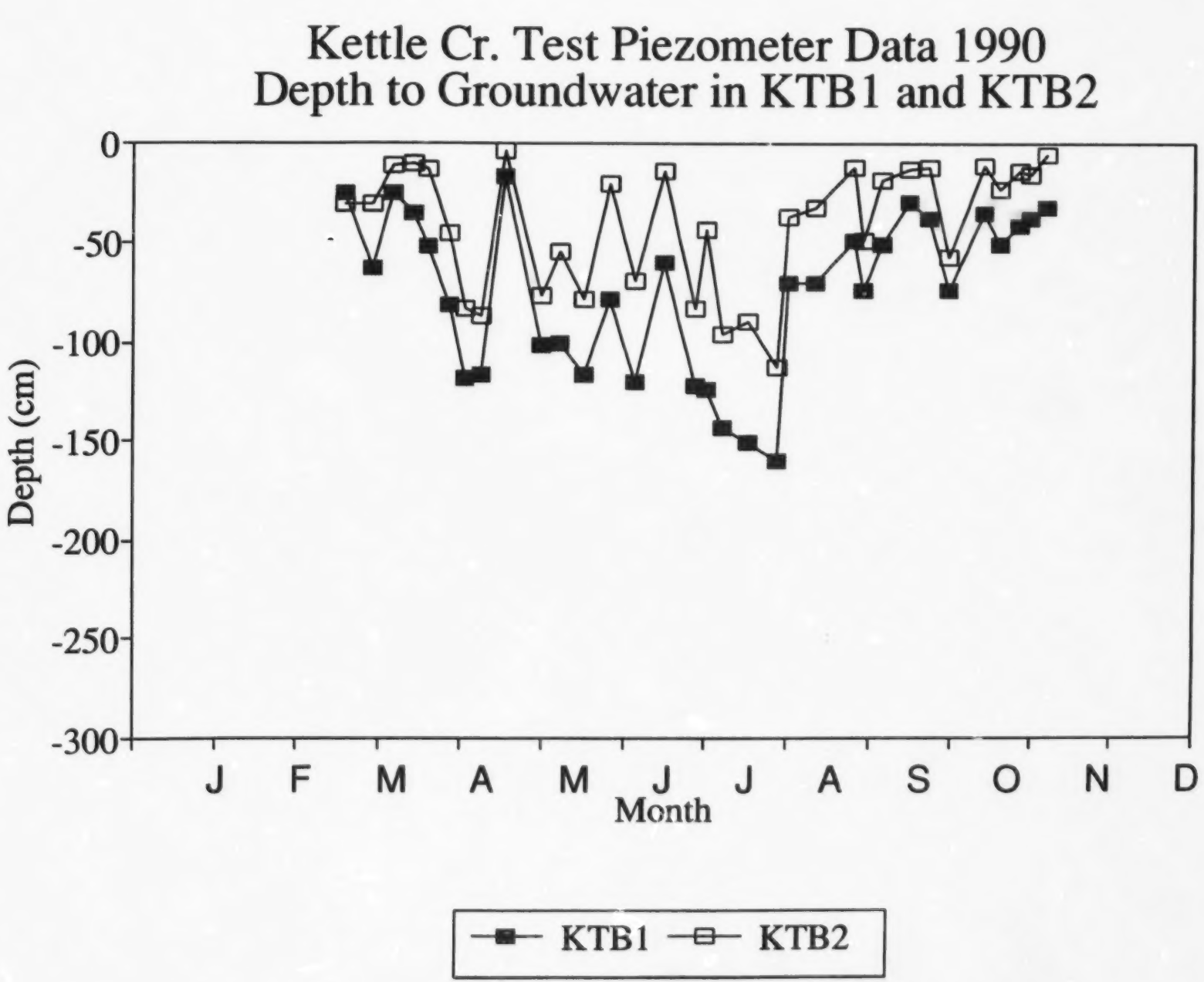
Pittock Test Piezometer Data-1989
Depth to Groundwater in PTB1 and PTB2

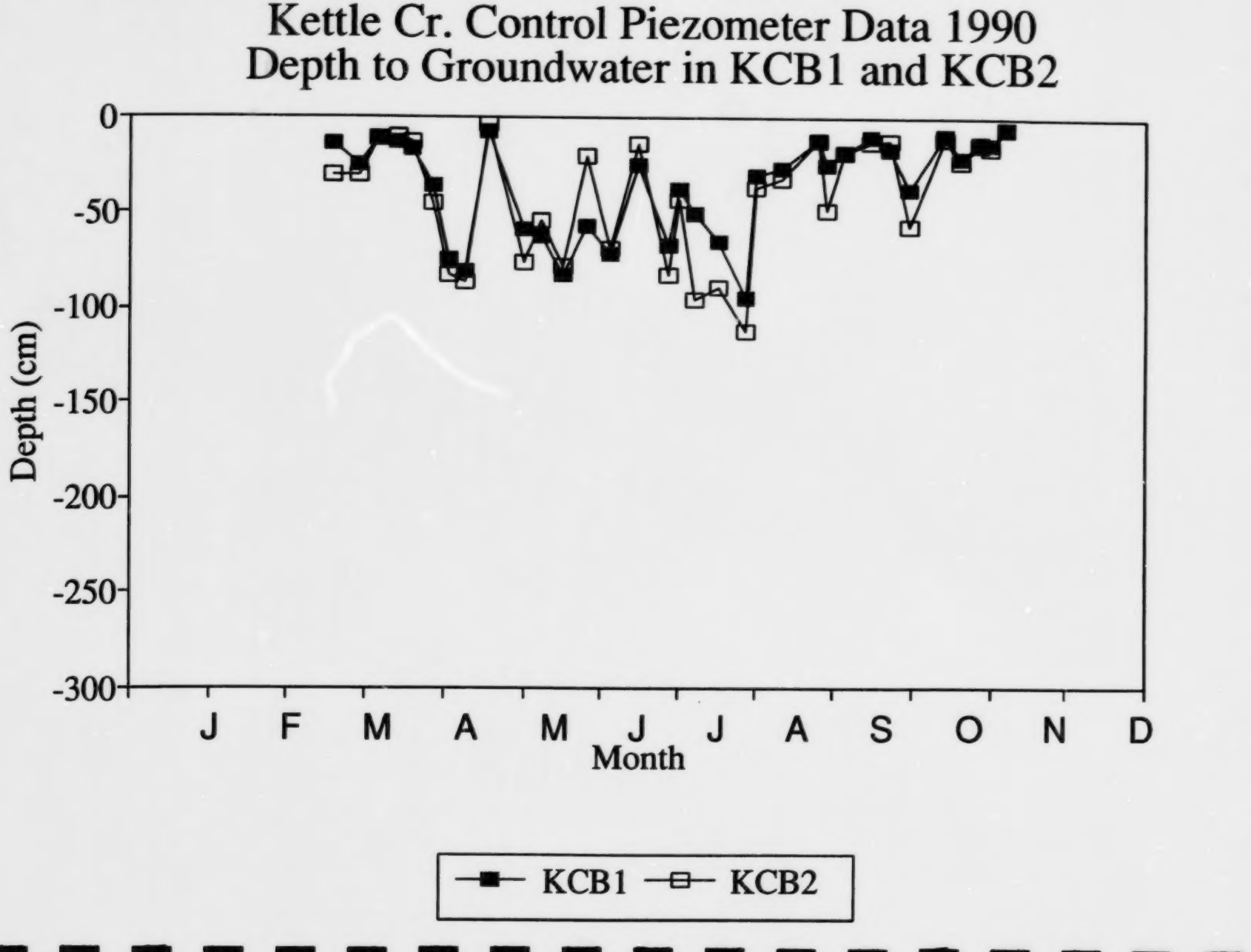


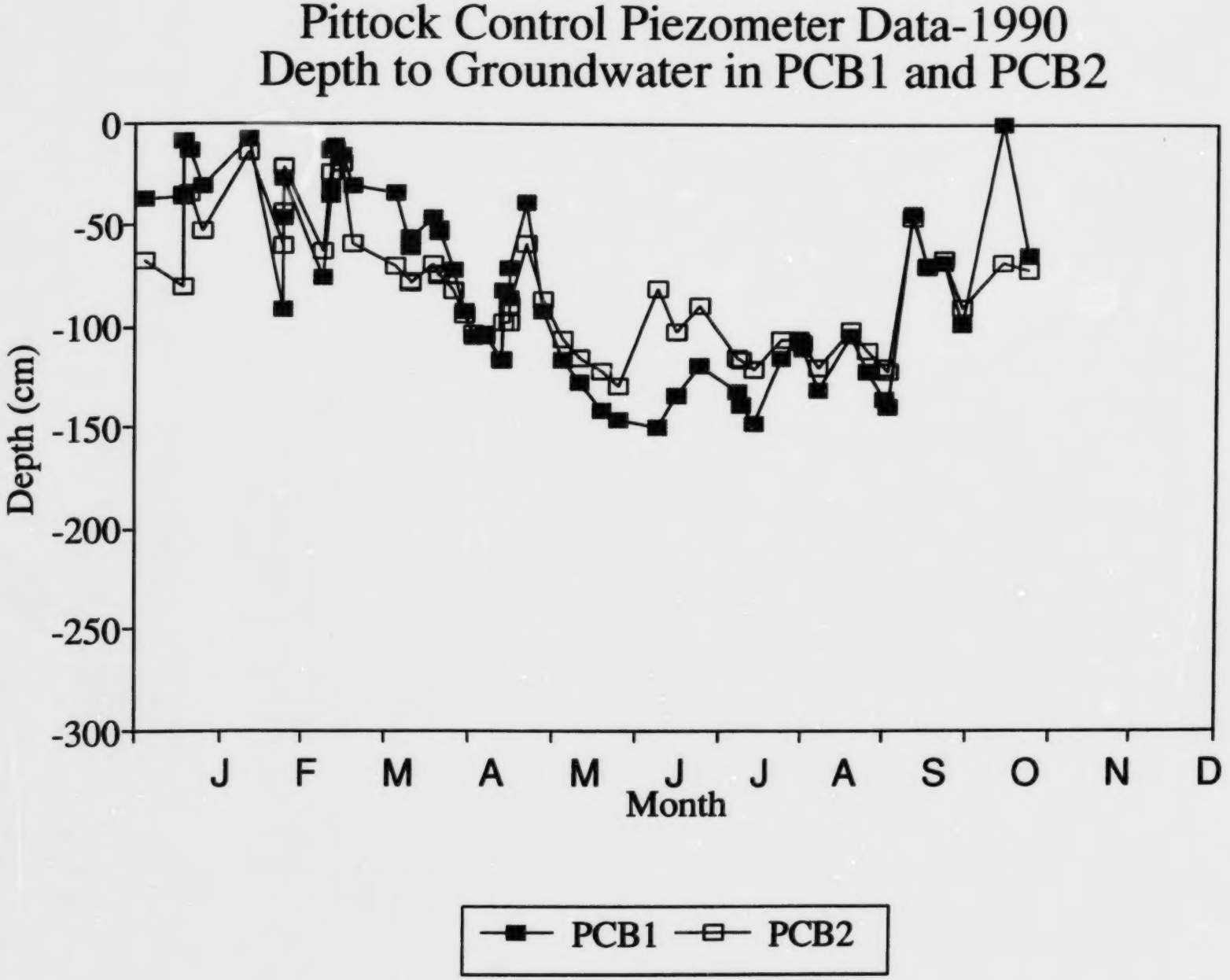
Essex Control Piezometer Data-1990
Depth to Groundwater in ECB1 and ECB2



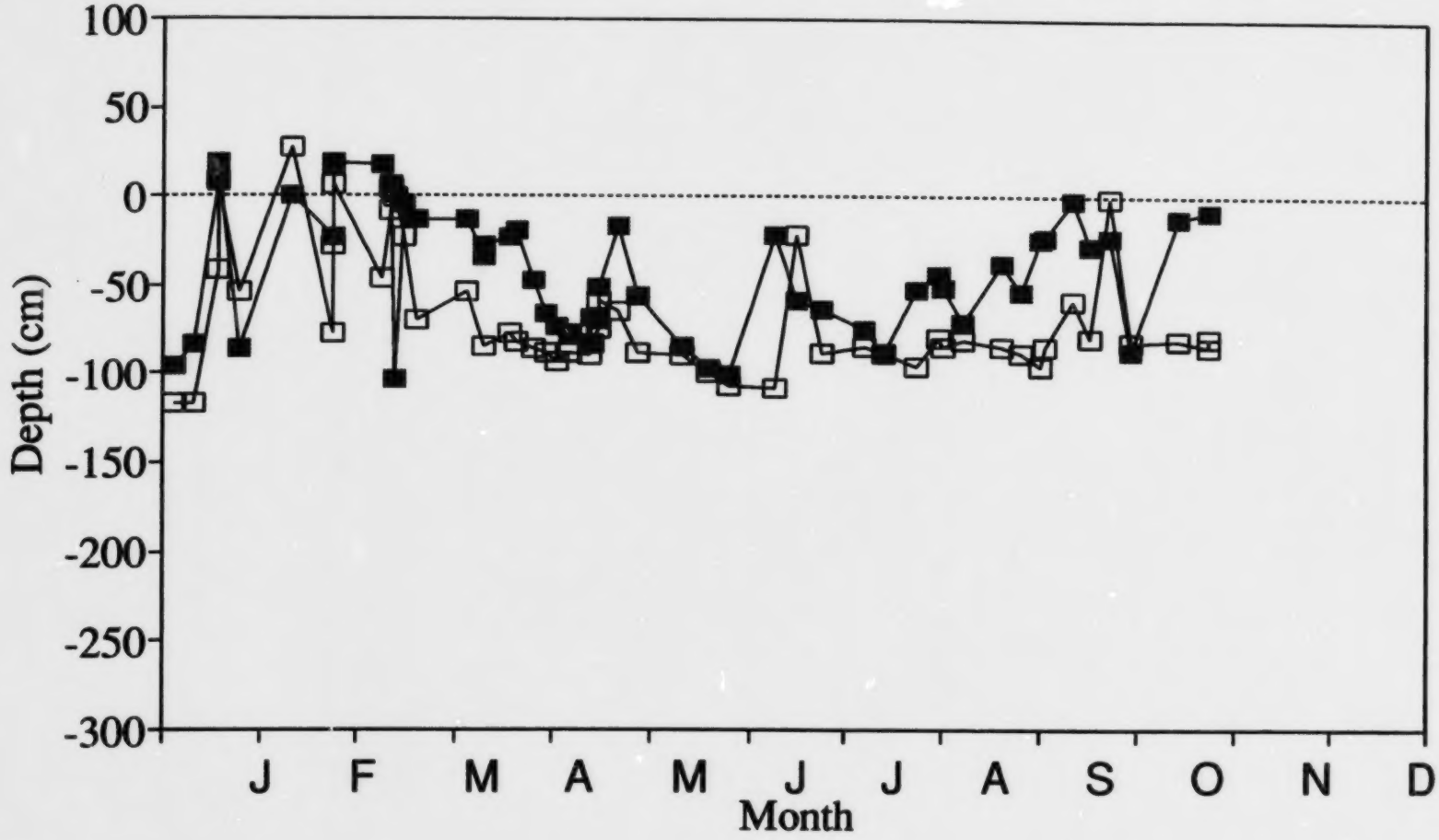

Essex Test Piezometer Data-1990
Depth to Groundwater in ETB1 and ETB2
0
-50
-100
-150
-200
-250
-300
Depth (cm)
J
F
M
A
M
J
J
A
S
O
N
D
Month
ETB1
ETB2


Kettle Cr. Test Piezometer Data 1990
Depth to Groundwater in KTB1 and KTB2
0
-50
-100
-150
-200
-250
-300
Depth (cm)
J
F
M
A
M
J
J
A
S
O
N
D
Month
KTB1
KTB2

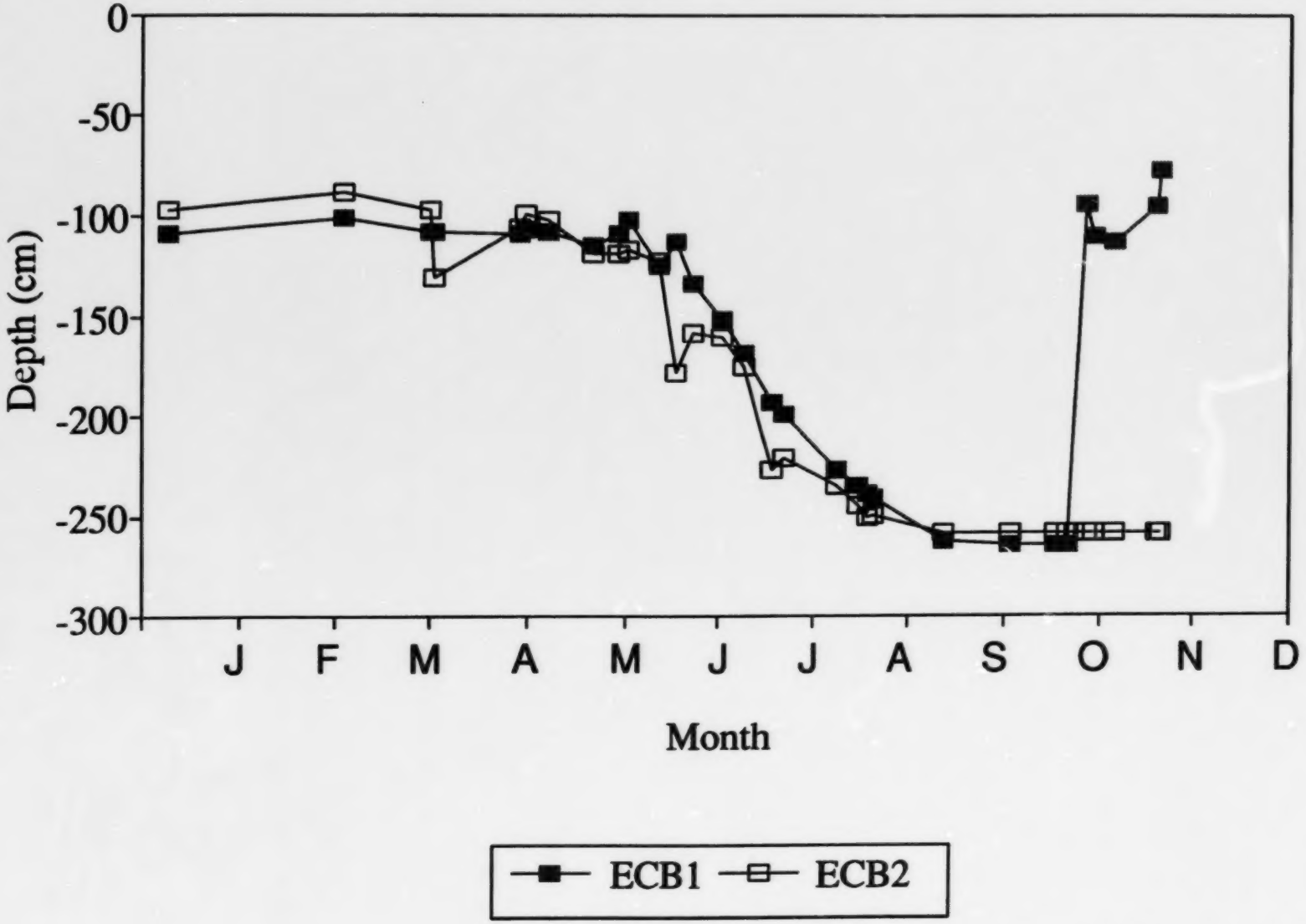

Kettle Cr. Control Piezometer Data 1990
Depth to Groundwater in KCB1 and KCB2
0
-50
-100
-150
-200
-250
-300
Depth (cm)
J
F
M
A
M
J
J
A
S
O
N
D
Month
KCB1
KCB2


Pittock Control Piezometer Data-1990
Depth to Groundwater in PCB1 and PCB2
0
-50
-100
-150
-200
-250
-300
Depth (cm)
J
F
M
A
M
J
J
A
S
O
N
D
Month
PCB1
PCB2

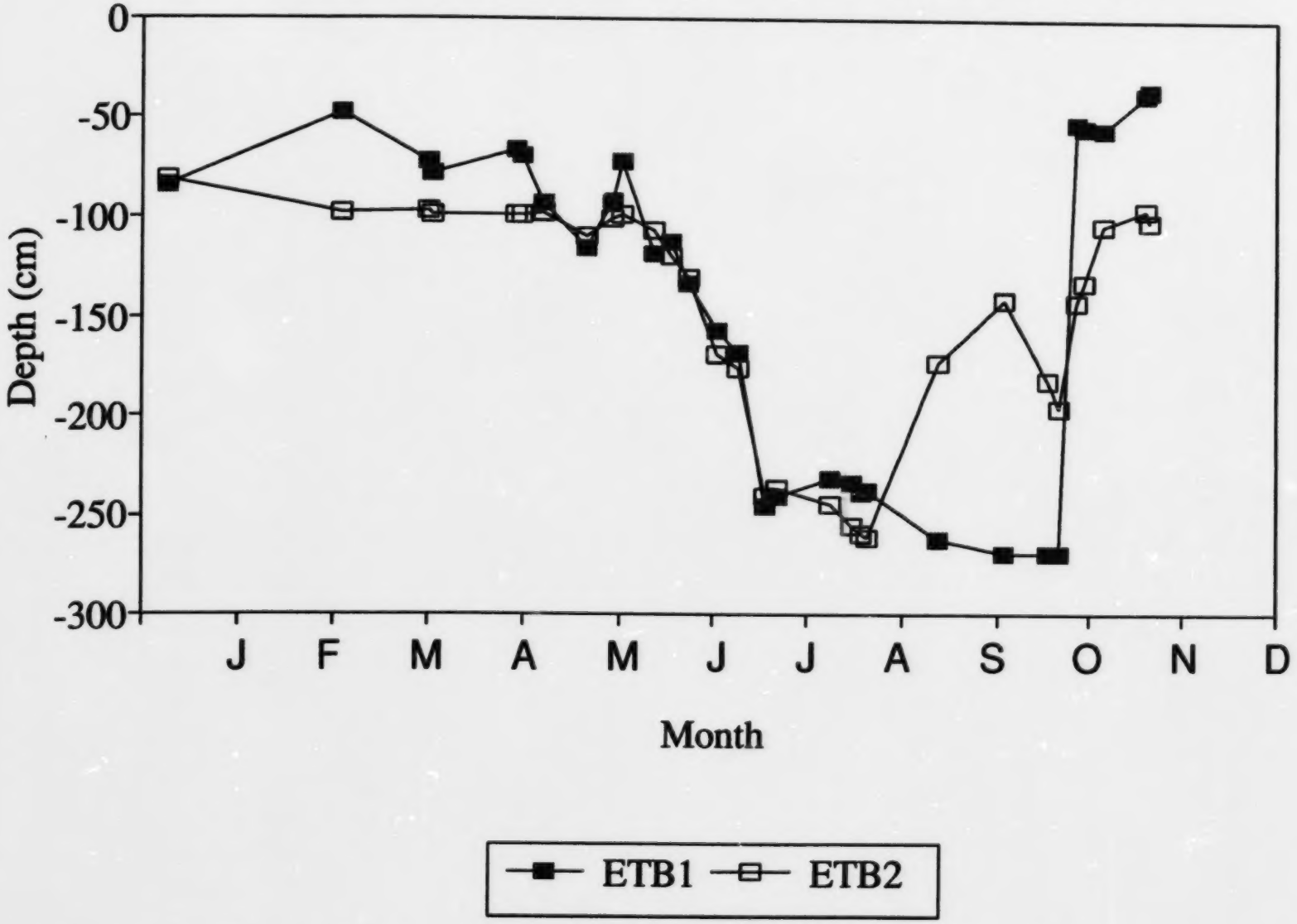
Pittock Test Piezometer Data-1990
Depth to Groundwater in PTB1 and PTB2

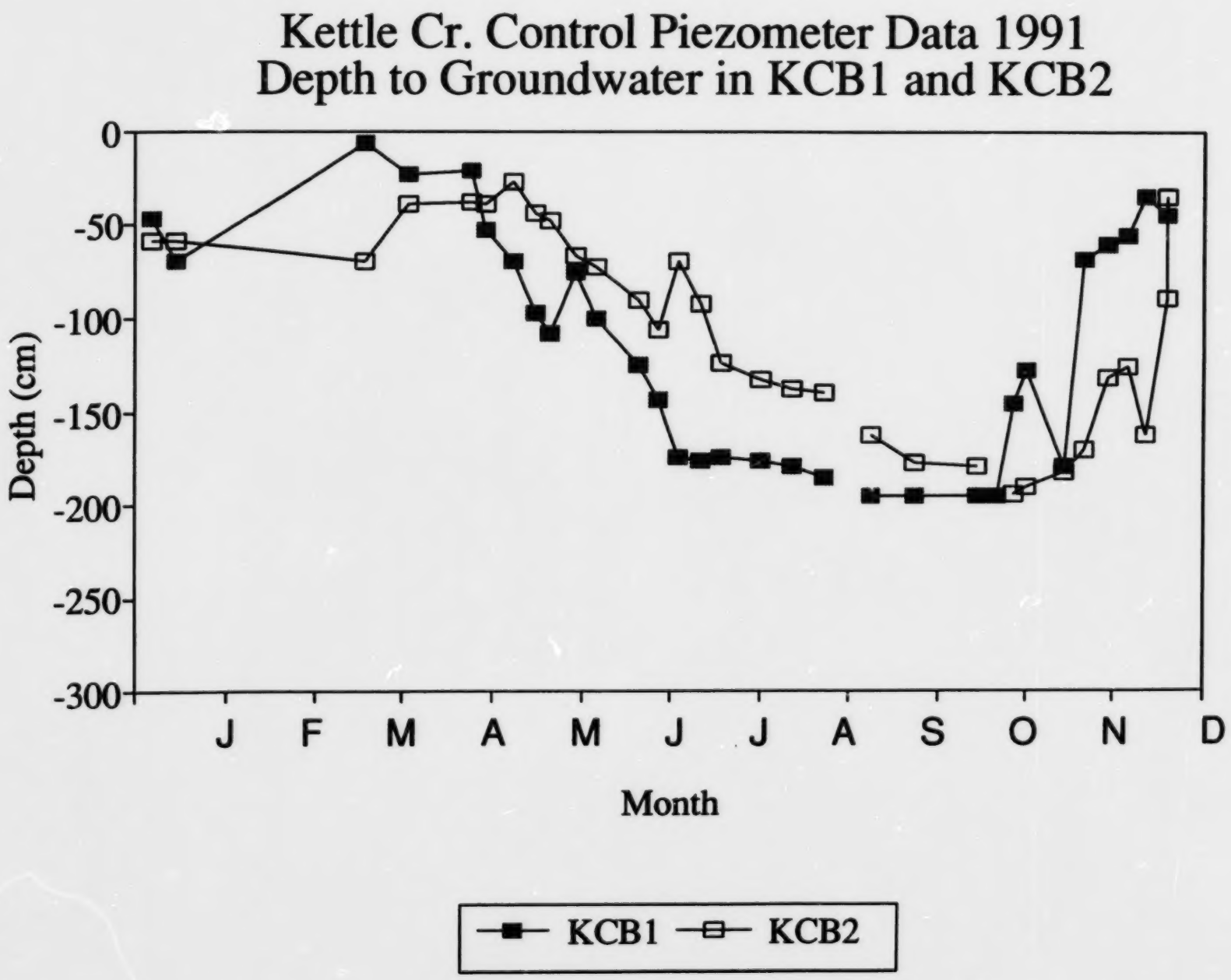


Essex Control Piezometer Data-1991
Depth to Groundwater in ECB1 and ECB2

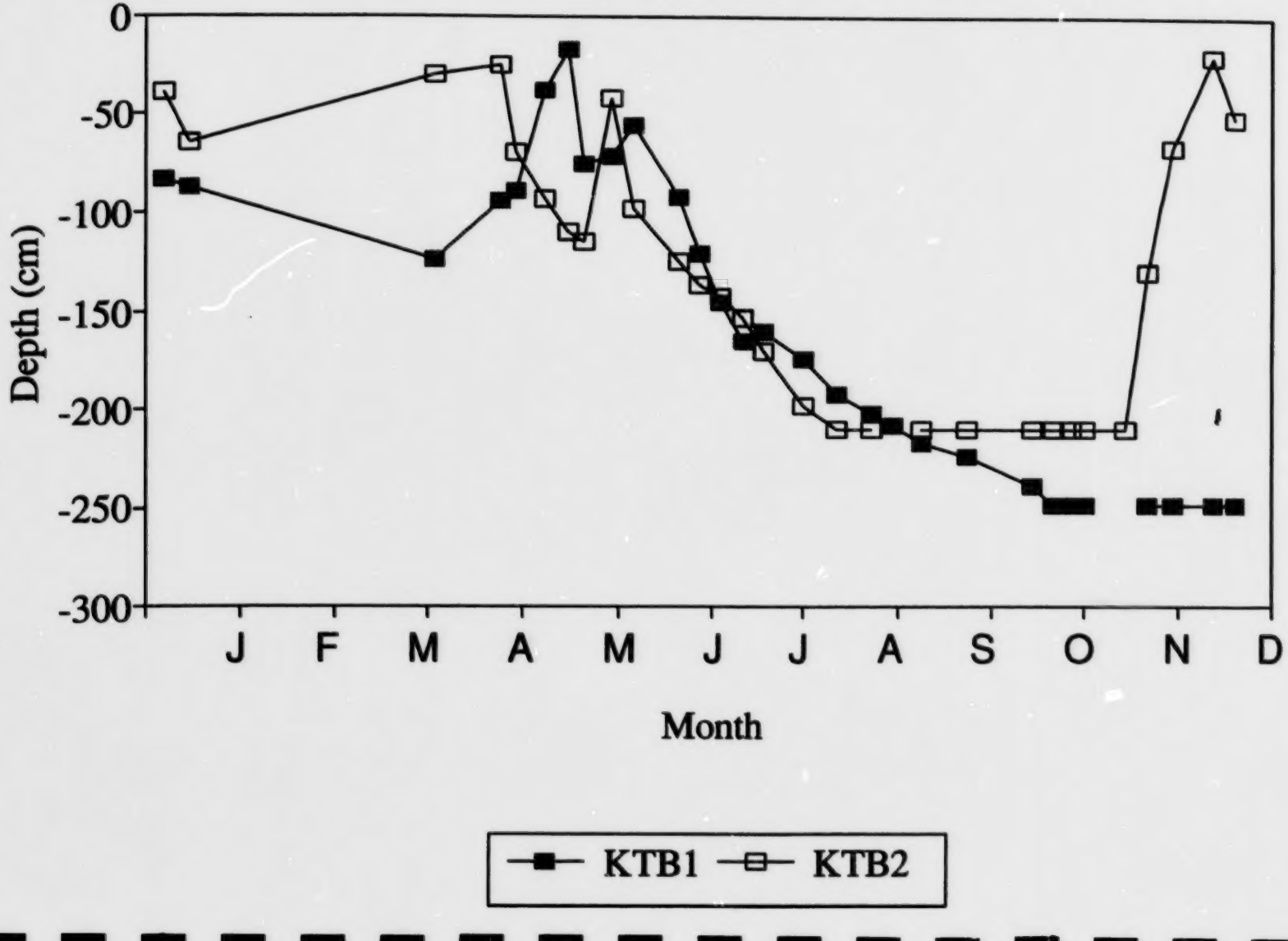


Essex Test Piezometer Data-1991
Depth to Groundwater in ETB1 and ETB2

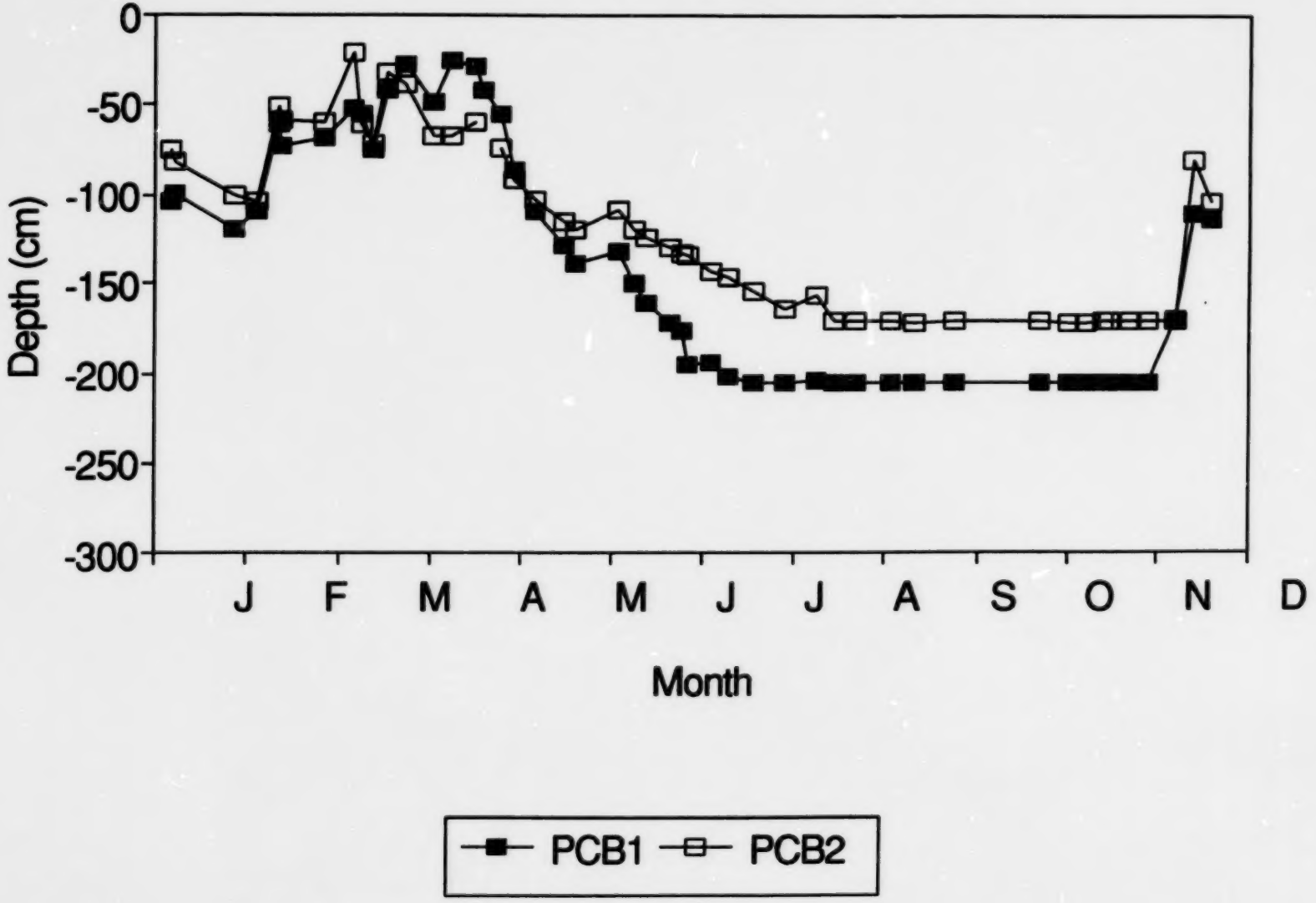



Kettle Cr. Control Piezometer Data 1991
Depth to Groundwater in KCB1 and KCB2
Depth (cm)
0
-50
-100
-150
-200
-250
-300
J
F
M
A
M
J
J
A
S
O
N
D
Month
KCB1
KCB2

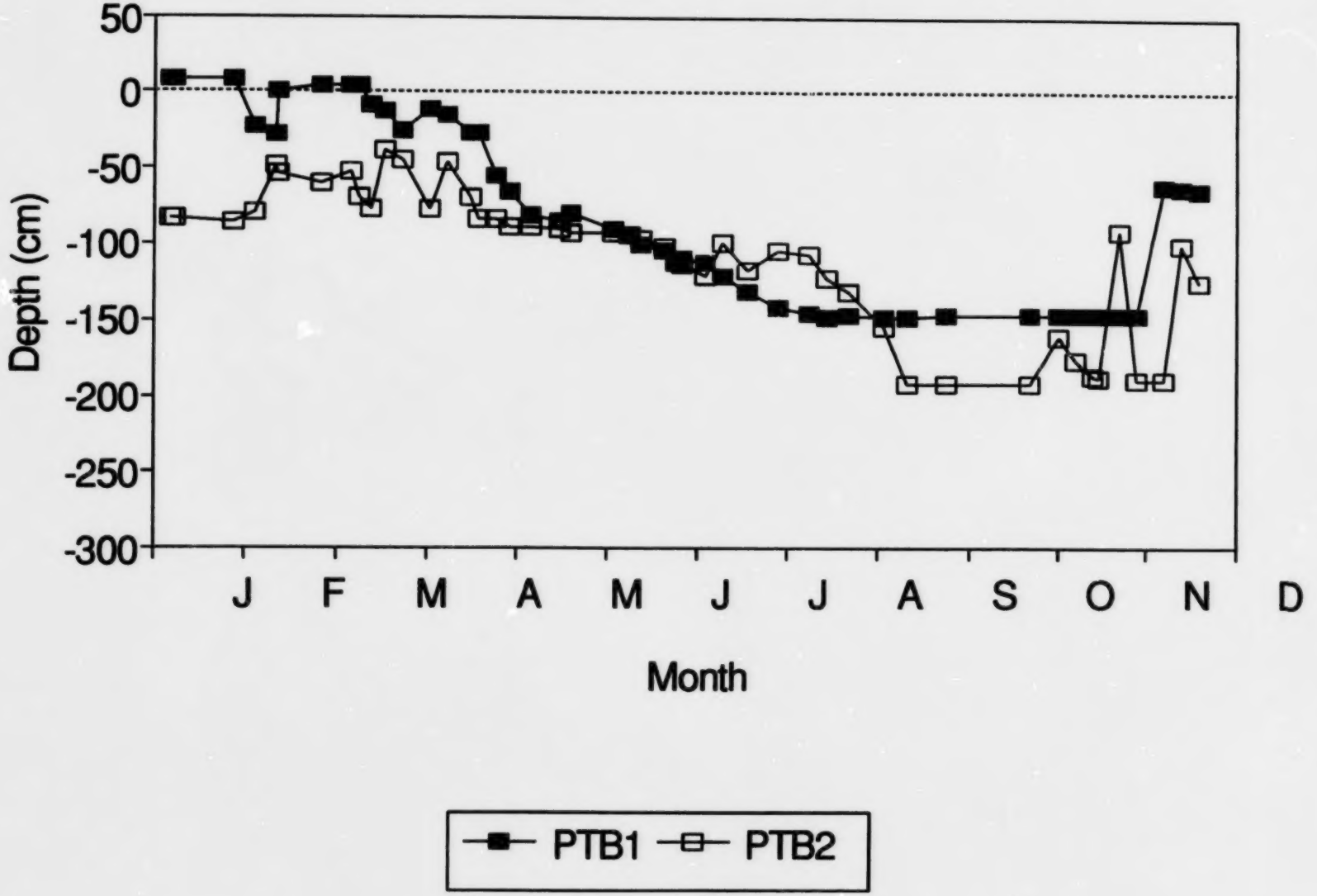
Kettle Cr. Test Piezometer Data 1991
Depth to Groundwater in KTB1 and KTB2



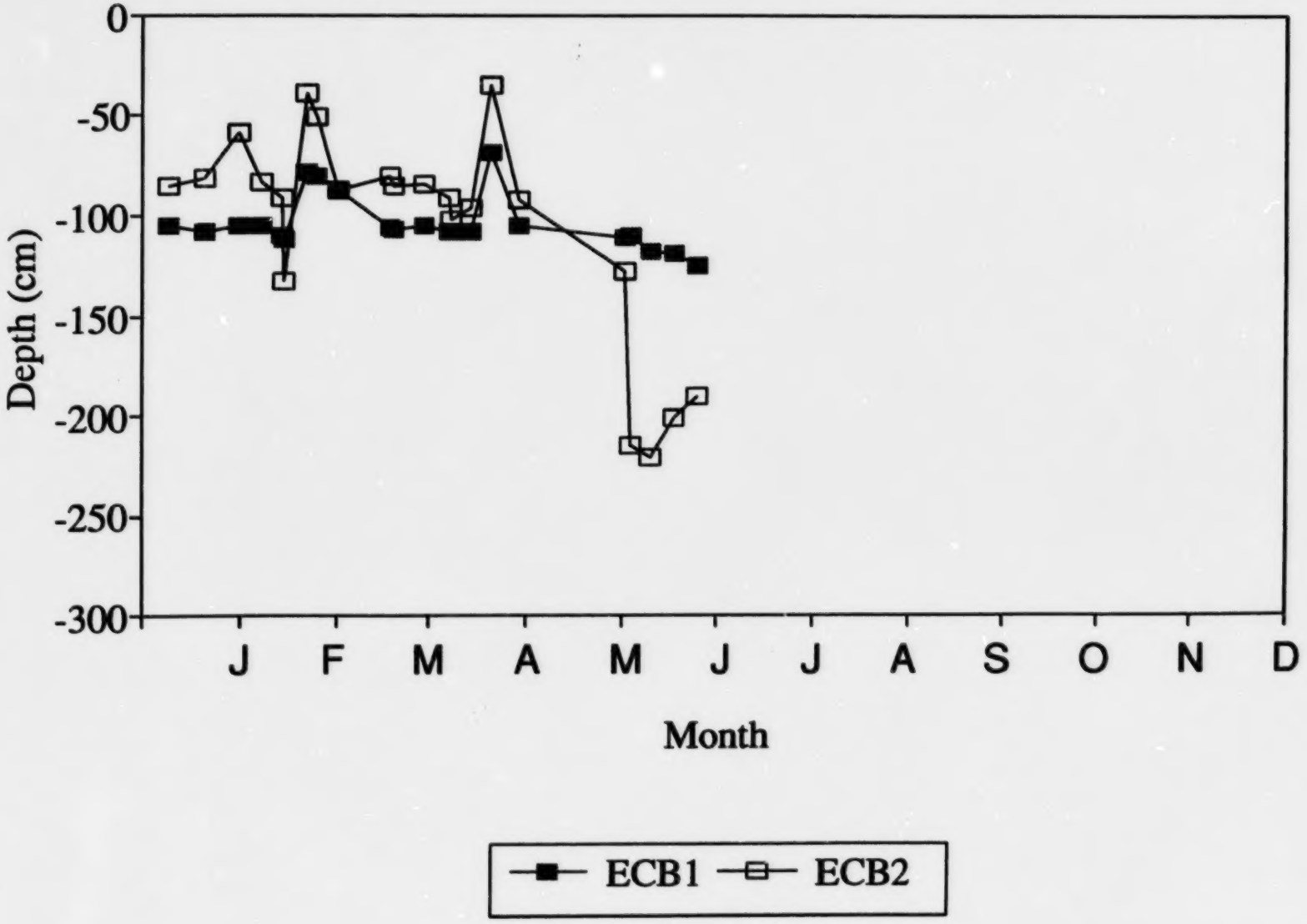
Pittock Control Piezometer Data 1991
Depth to Groundwater in PCB1 and PCB2

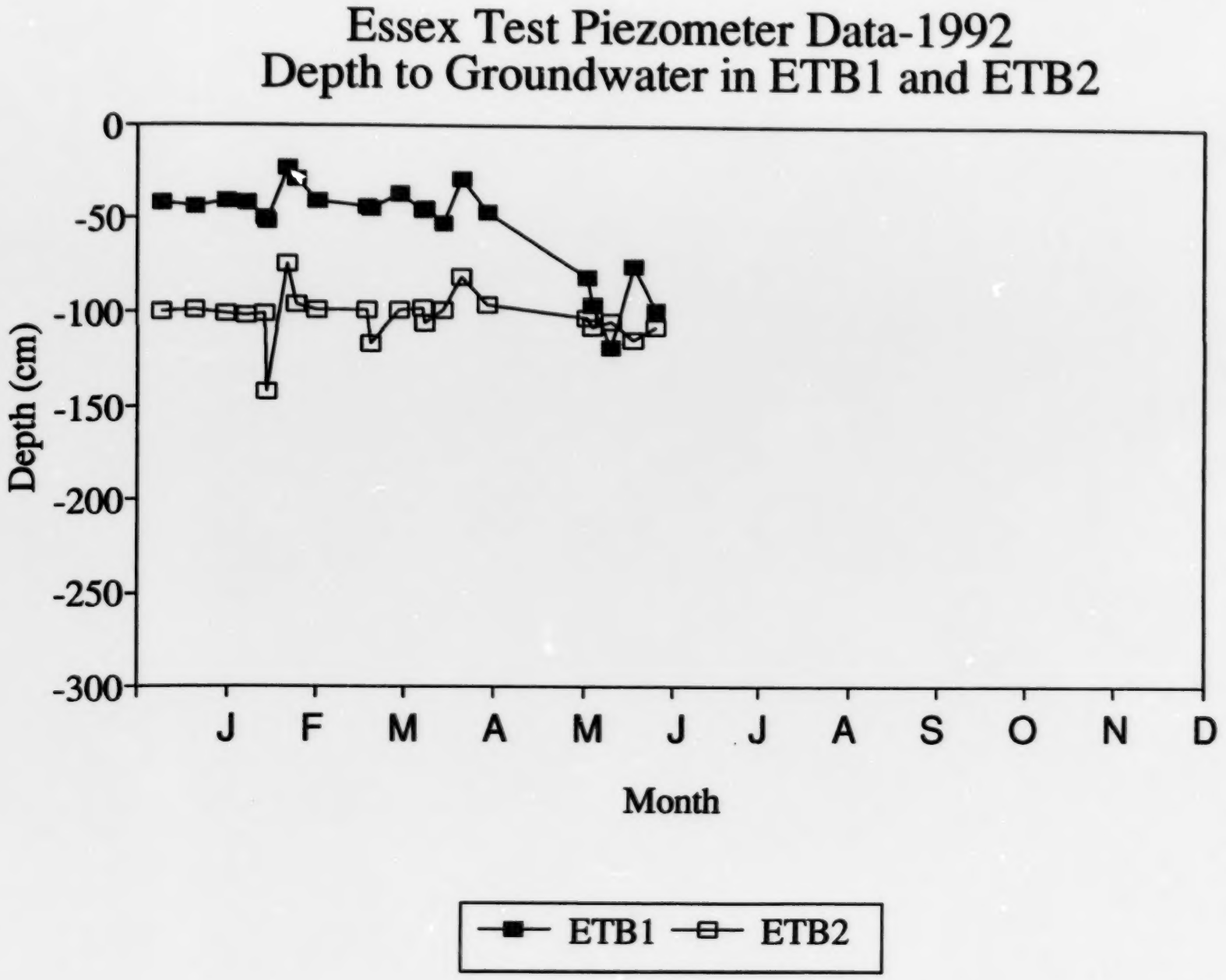


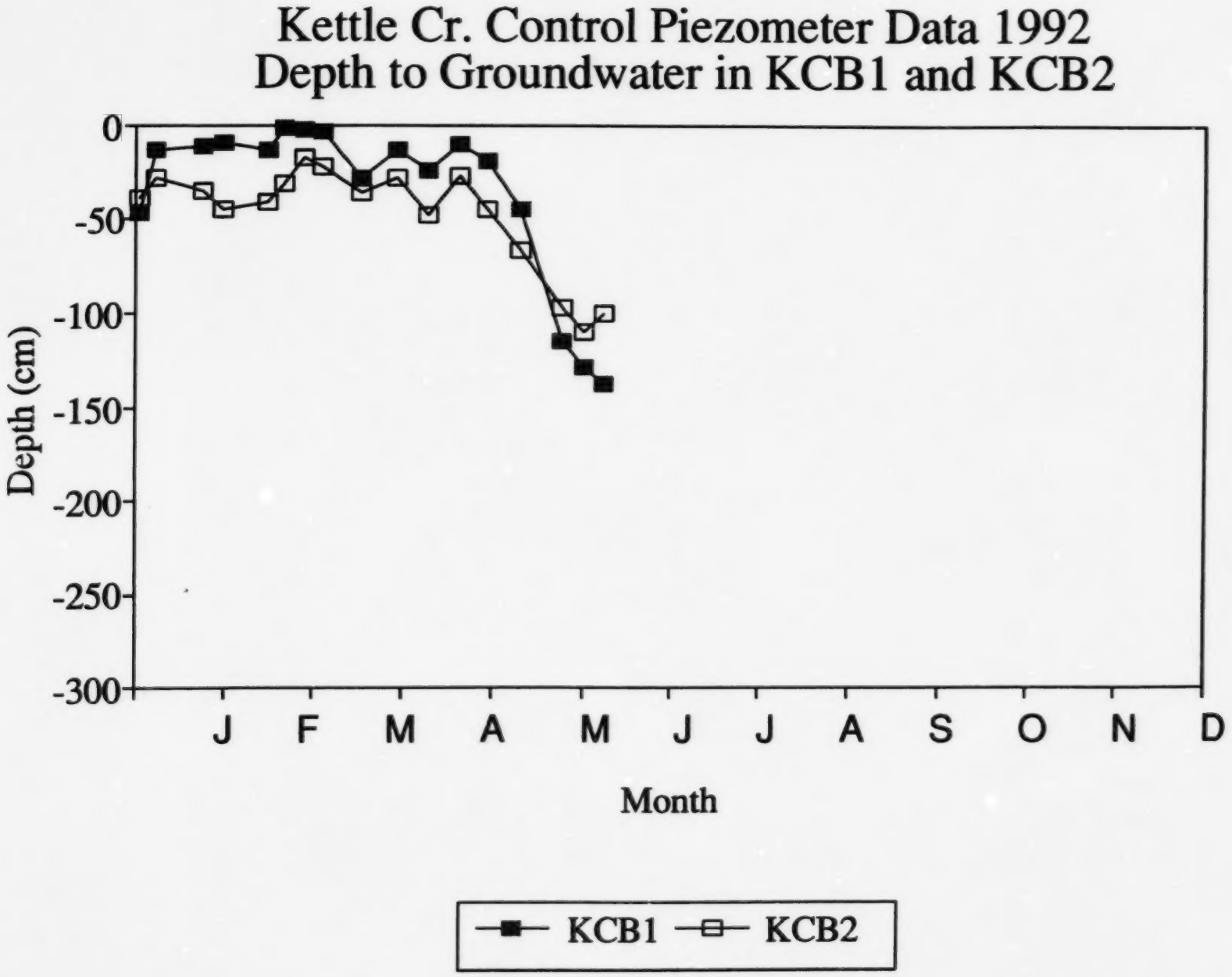
Pittock Test Piezometer Data 1991
Depth to Groundwater in PTB1 and PTB2

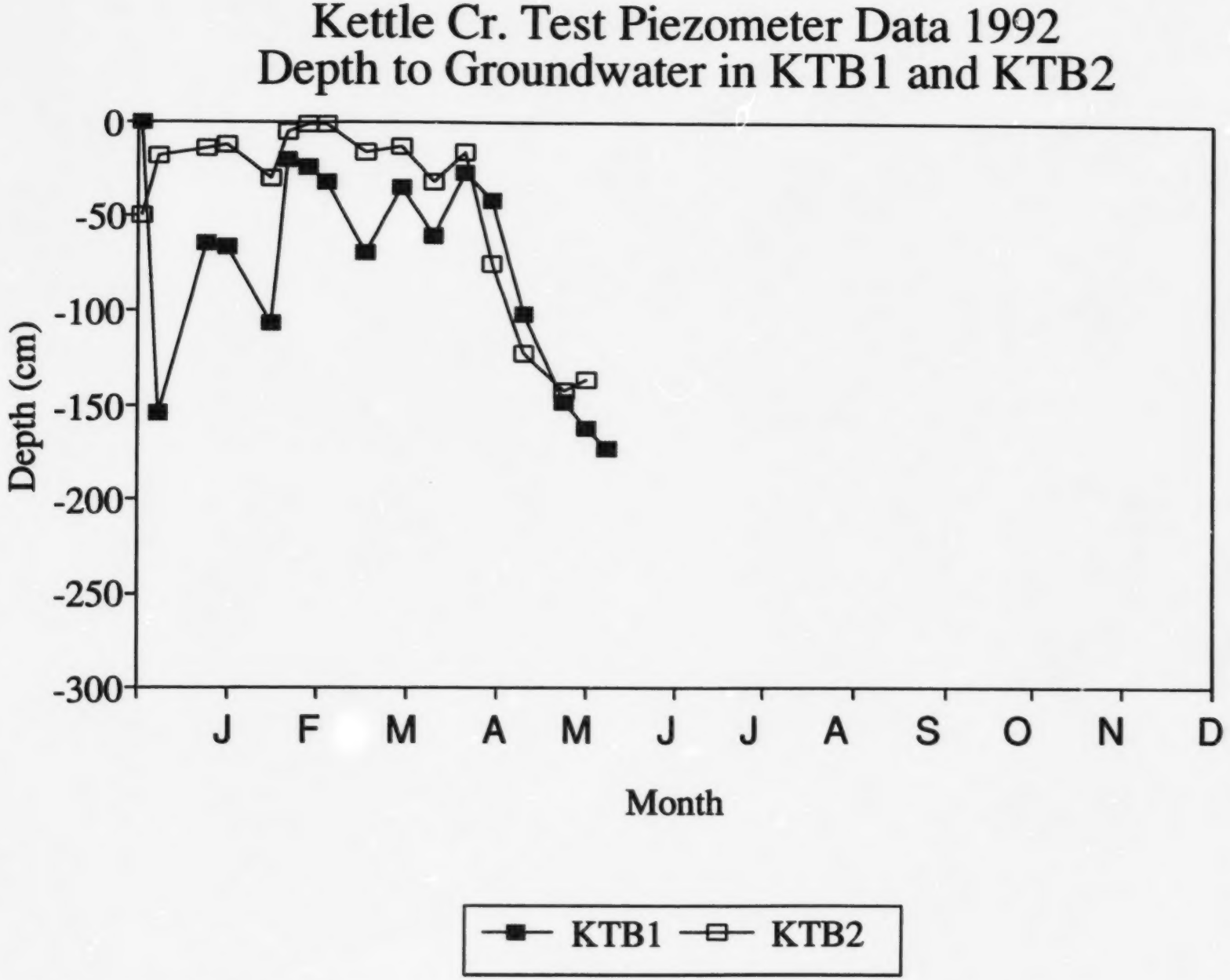


Essex Control Piezometer Data-1992
Depth to Groundwater in ECB1 and ECB2

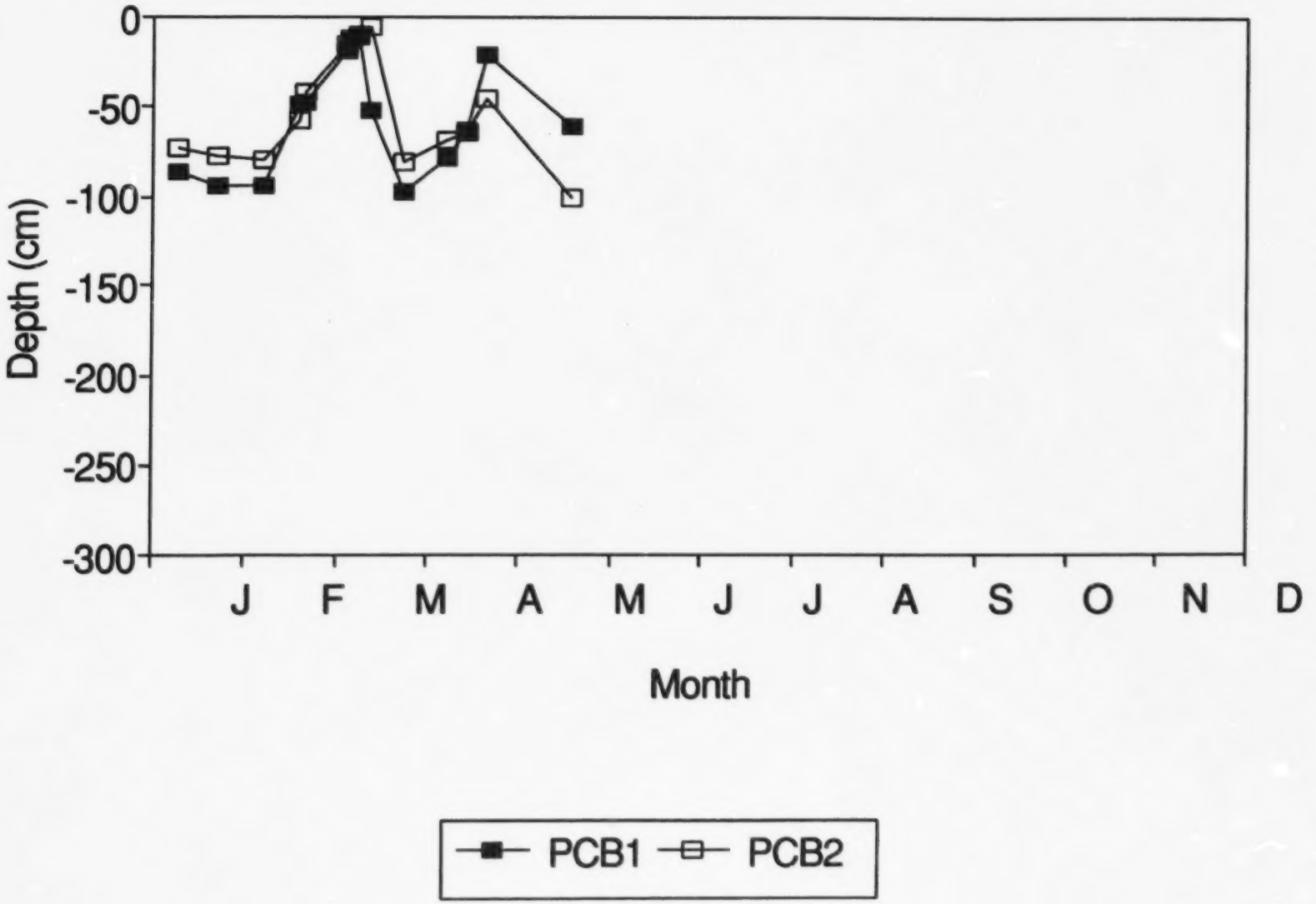



Essex Test Piezometer Data-1992
Depth to Groundwater in ETB1 and ETB2
0
-50
-100
-150
-200
-250
-300
Depth (cm)
J
F
M
A
M
J
J
A
S
O
N
D
Month
ETB1
ETB2

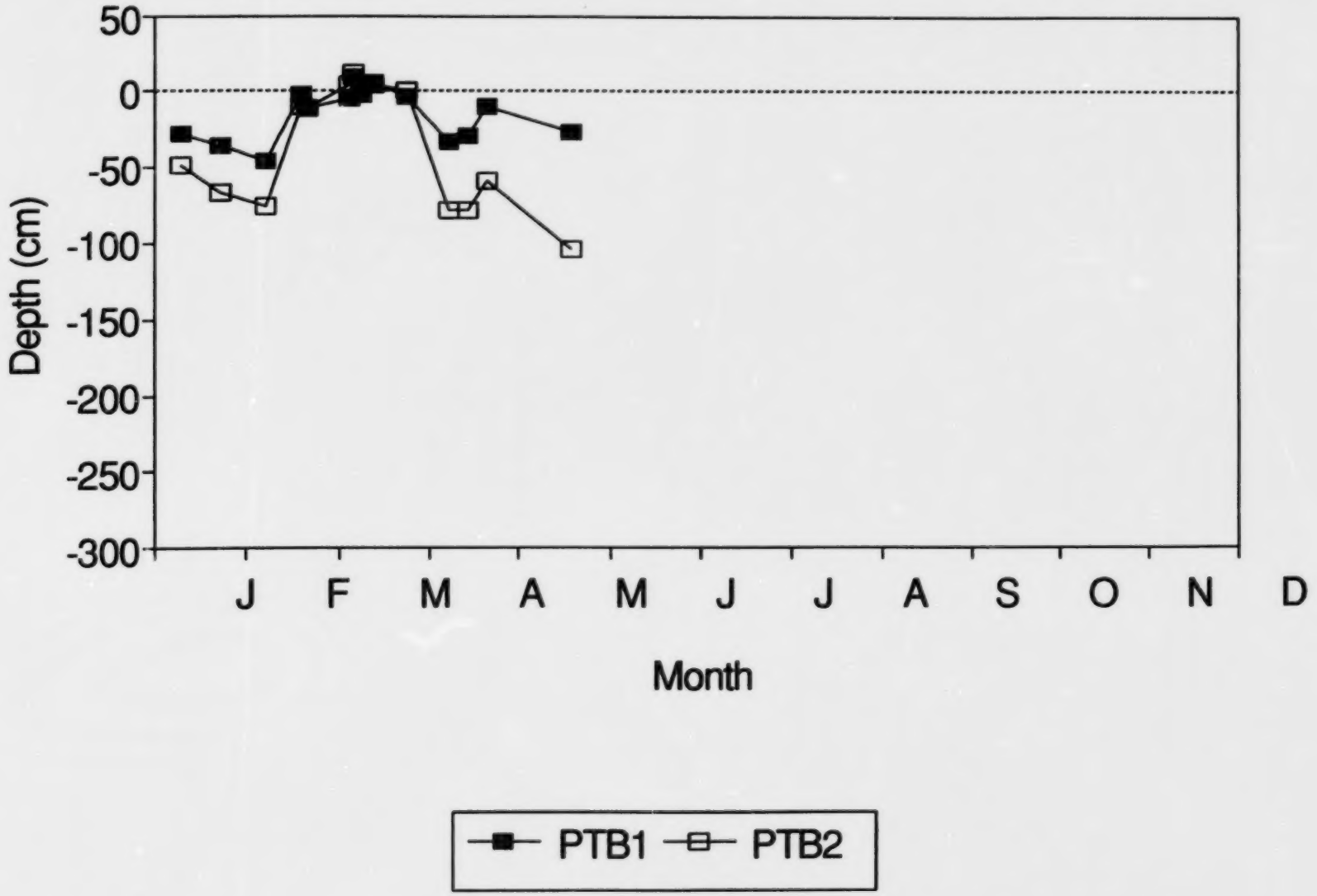

Kettle Cr. Control Piezometer Data 1992
Depth to Groundwater in KCB1 and KCB2
0
-50
-100
-150
-200
-250
-300
Depth (cm)
J
F
M
A
M
J
J
A
S
O
N
D
Month
KCB1
KCB2


Kettle Cr. Test Piezometer Data 1992
Depth to Groundwater in KTB1 and KTB2
0
-50
-100
-150
-200
-250
-300
Depth (cm)
J
F
M
A
M
J
J
A
S
O
N
D
Month
KTB1
KTB2

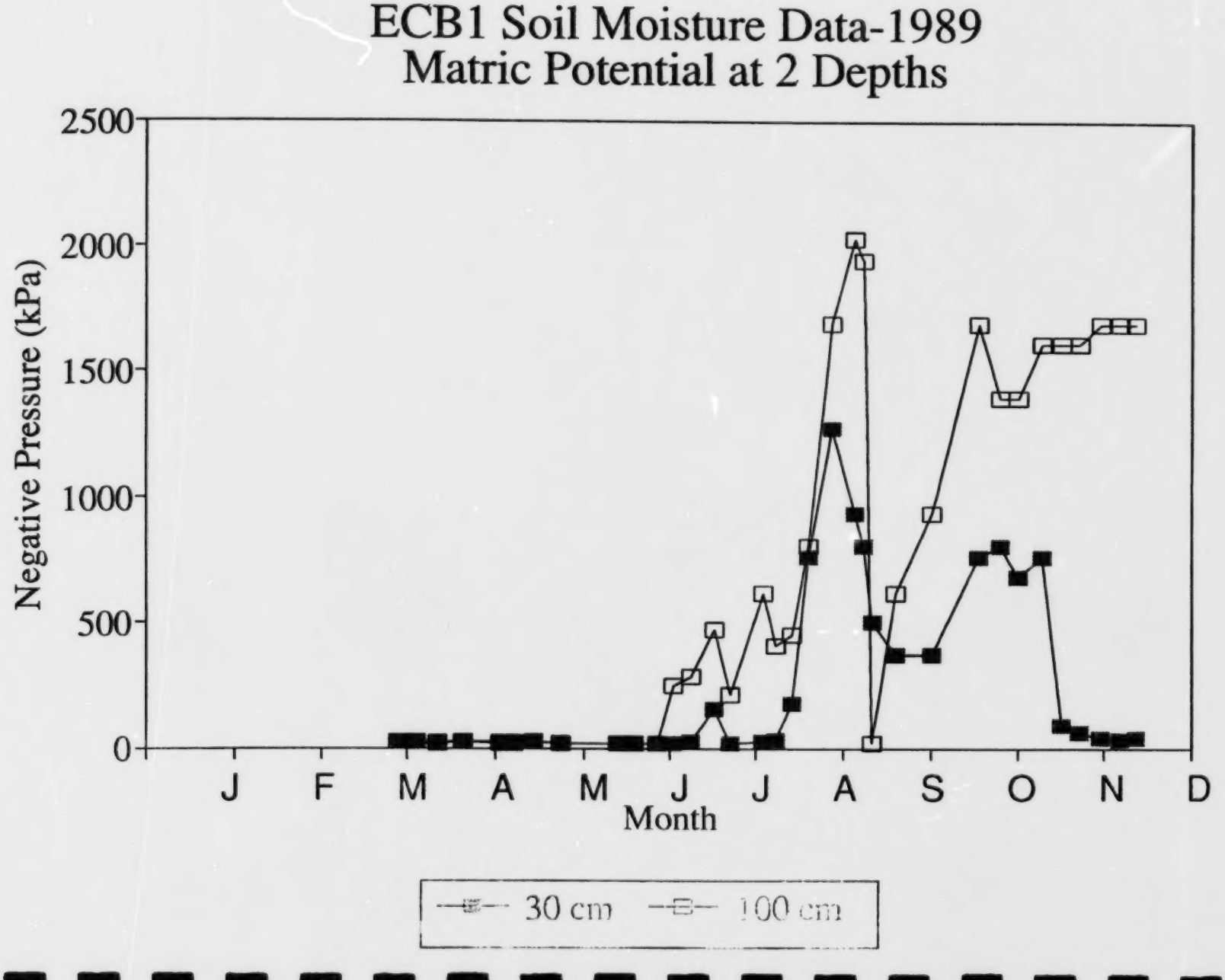
Pittock Control Piezometer Data 1992
Depth to Groundwater in PCB1 and PCB2



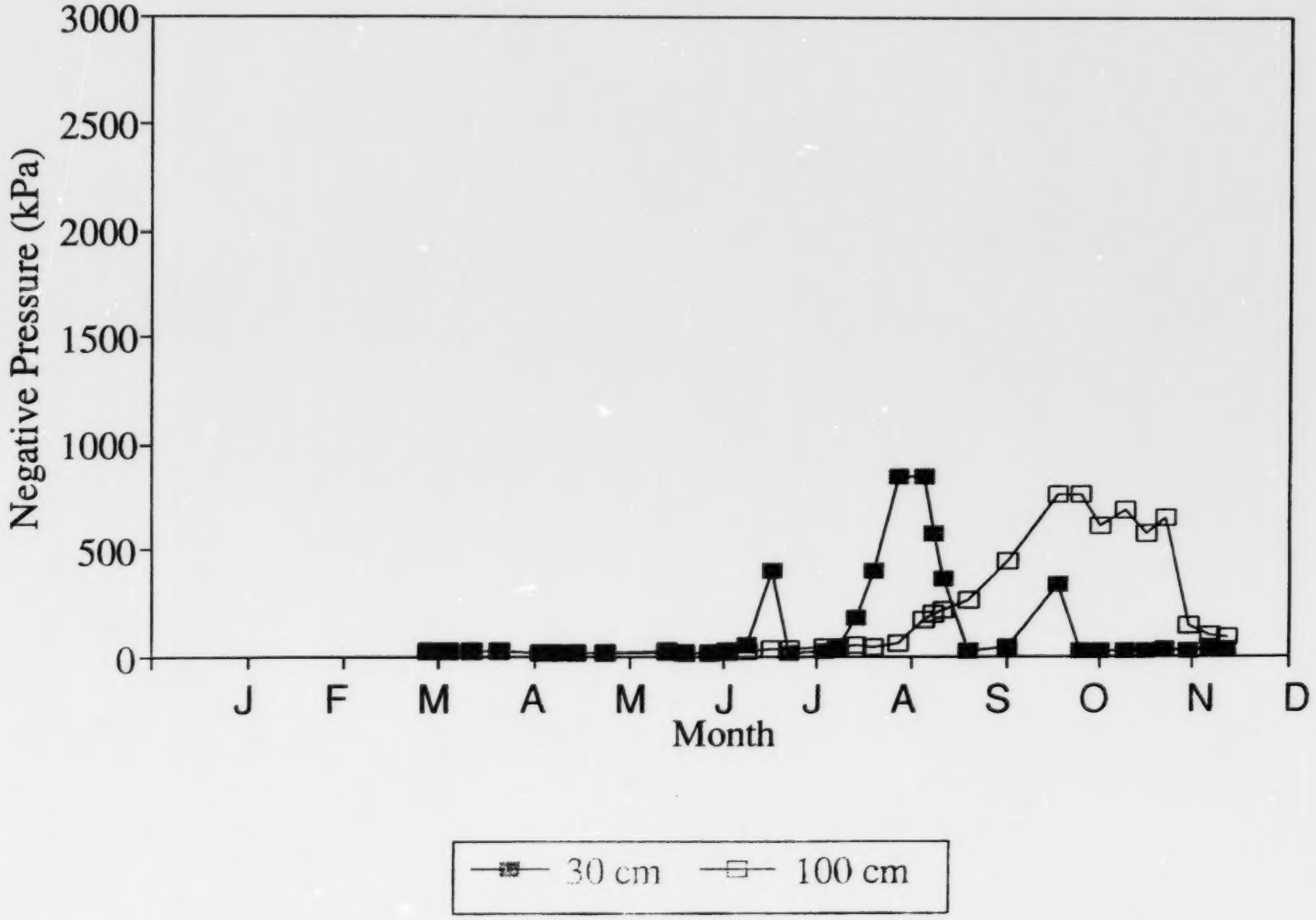
Pittock Test Piezometer Data 1992
Depth to Groundwater in PTB1 and PTB2



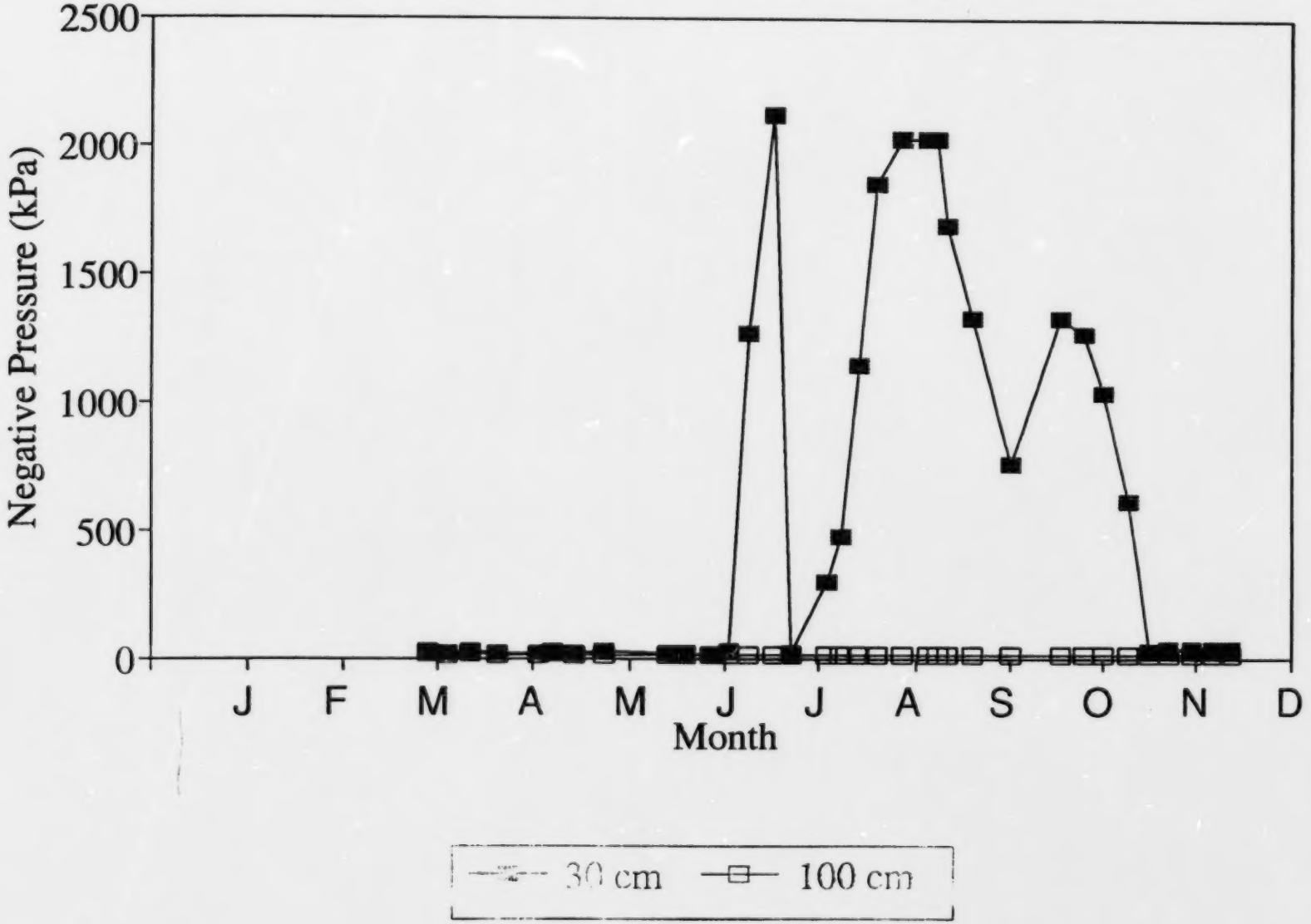
SOIL MOISTURE LEVELS AT 2 DEPTHS


ECB1 Soil Moisture Data-1989
Matric Potential at 2 Depths
Negative Pressure (kPa)
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

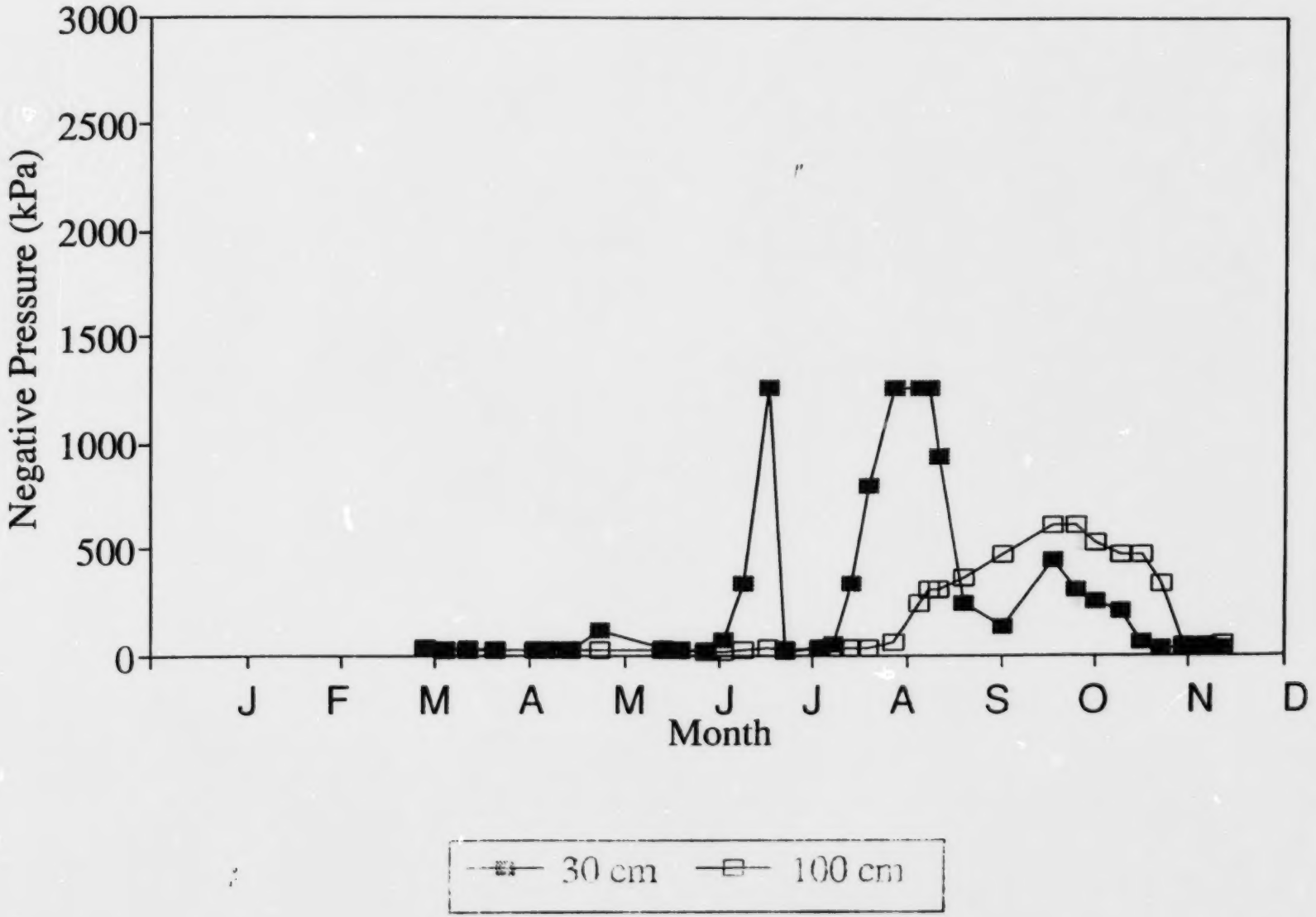
ECB2 Soil Moisture Data-1989
Matric Potential at 2 Depths



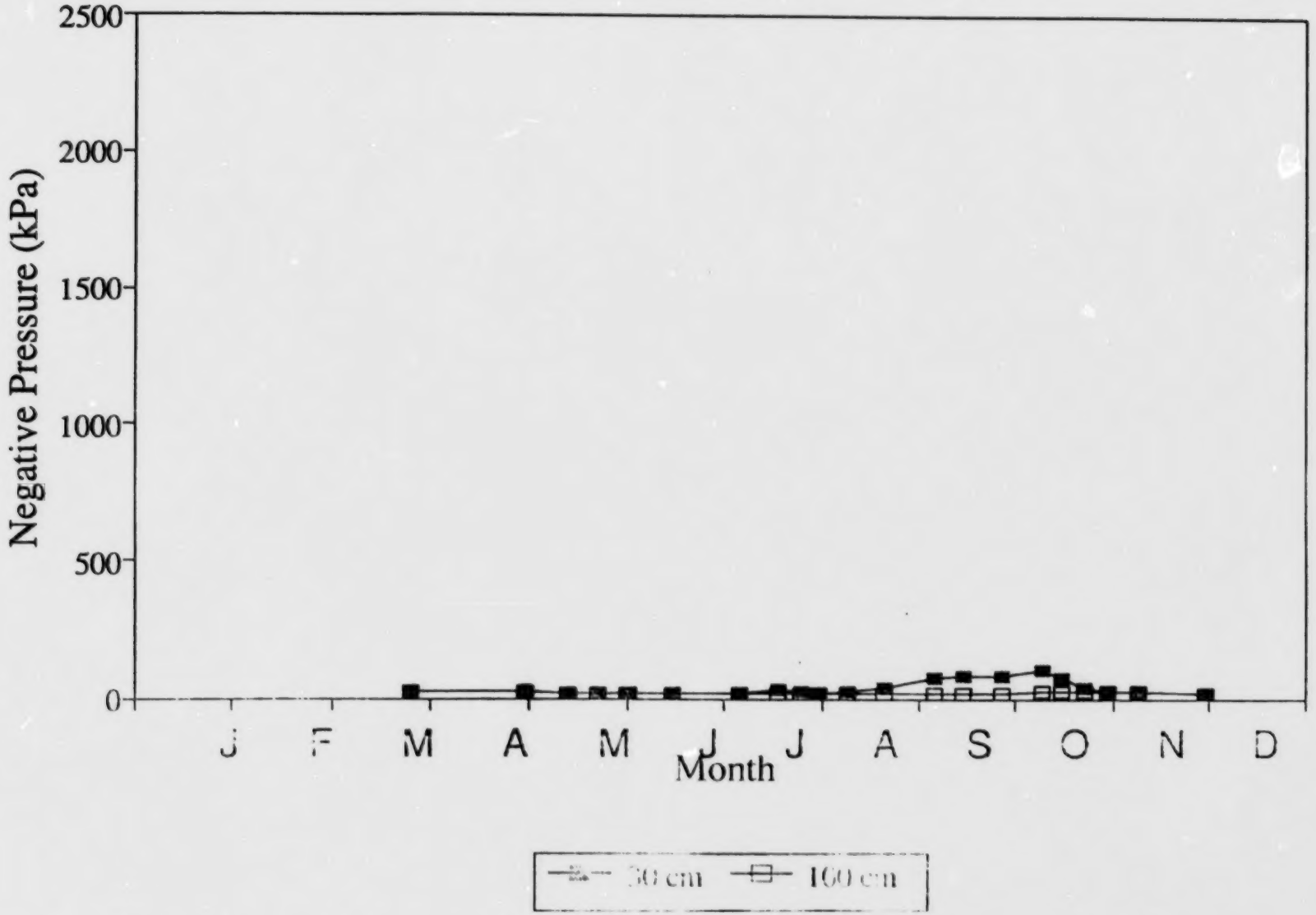
ETB1 Soil Moisture Data-1989
Matric Potential at 2 Depths



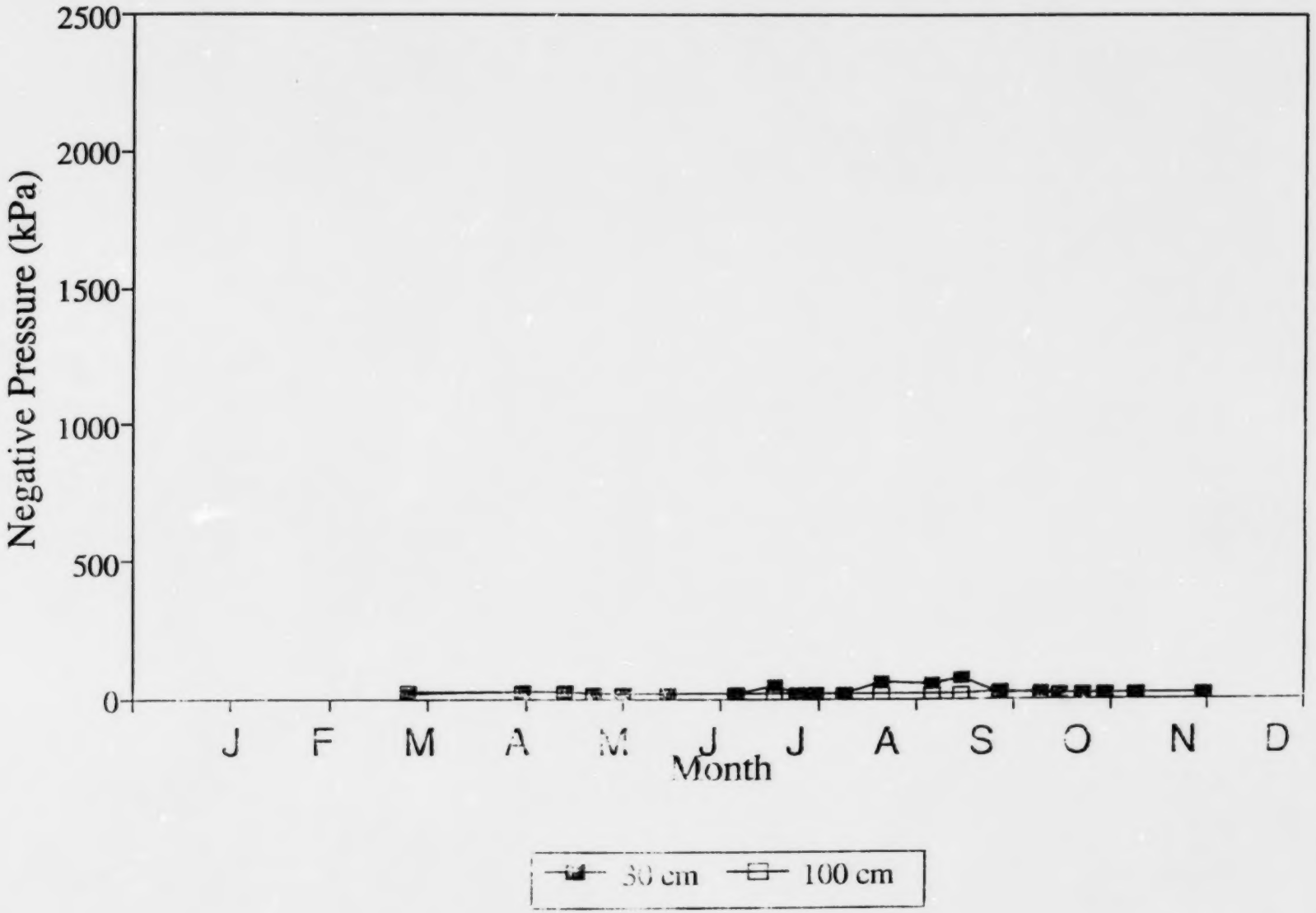
ETB2 Soil Moisture Data-1989
Matric Potential at 2 Depths



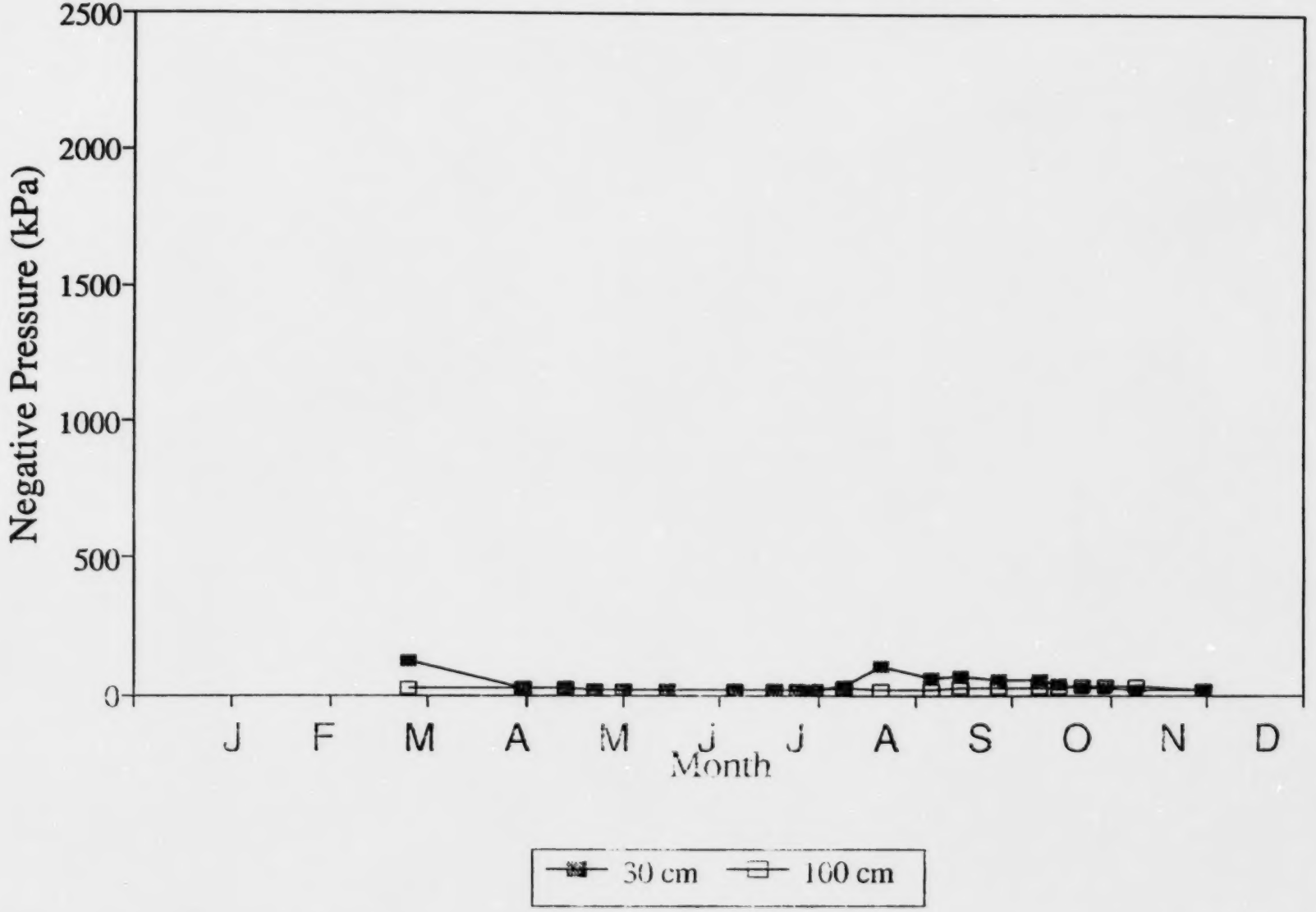
KCB1 Soil Moisture Data 1989
Matric Potential at 2 Depths



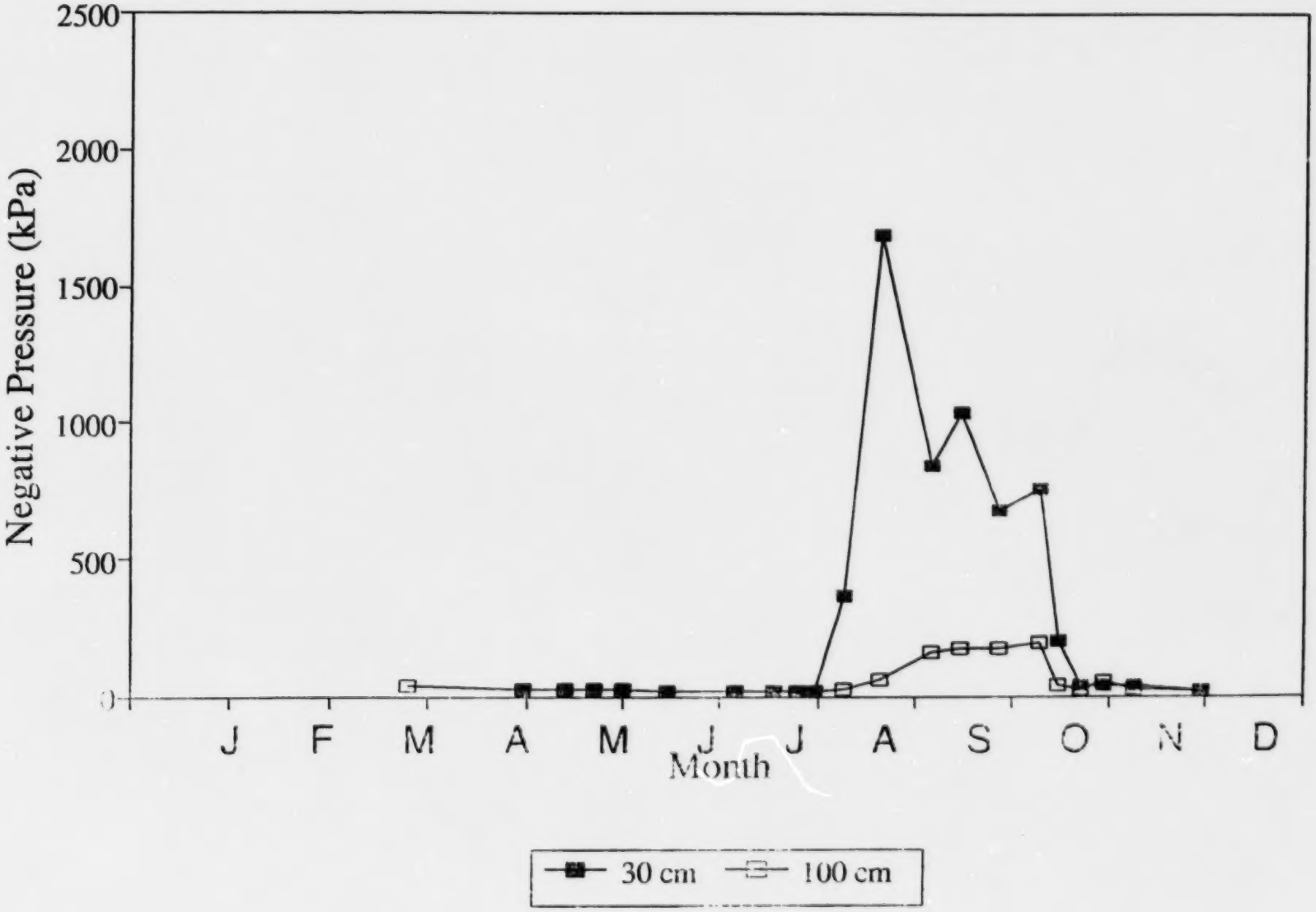
KCB2 Soil Moisture Data 1989
Matric Potential at 2 Depths



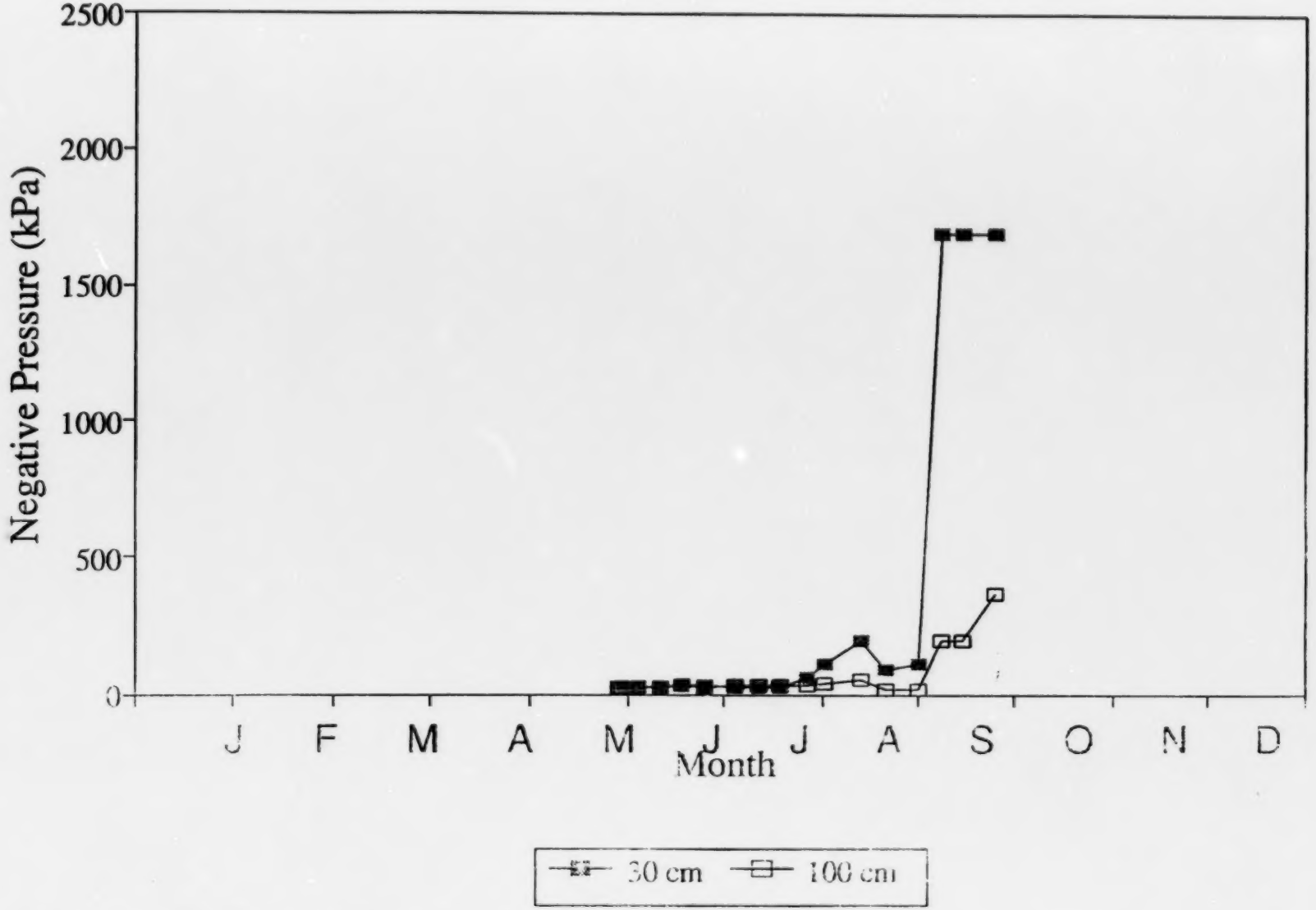
KTB1 Soil Moisture Data 1989
Matric Potential at 2 Depths



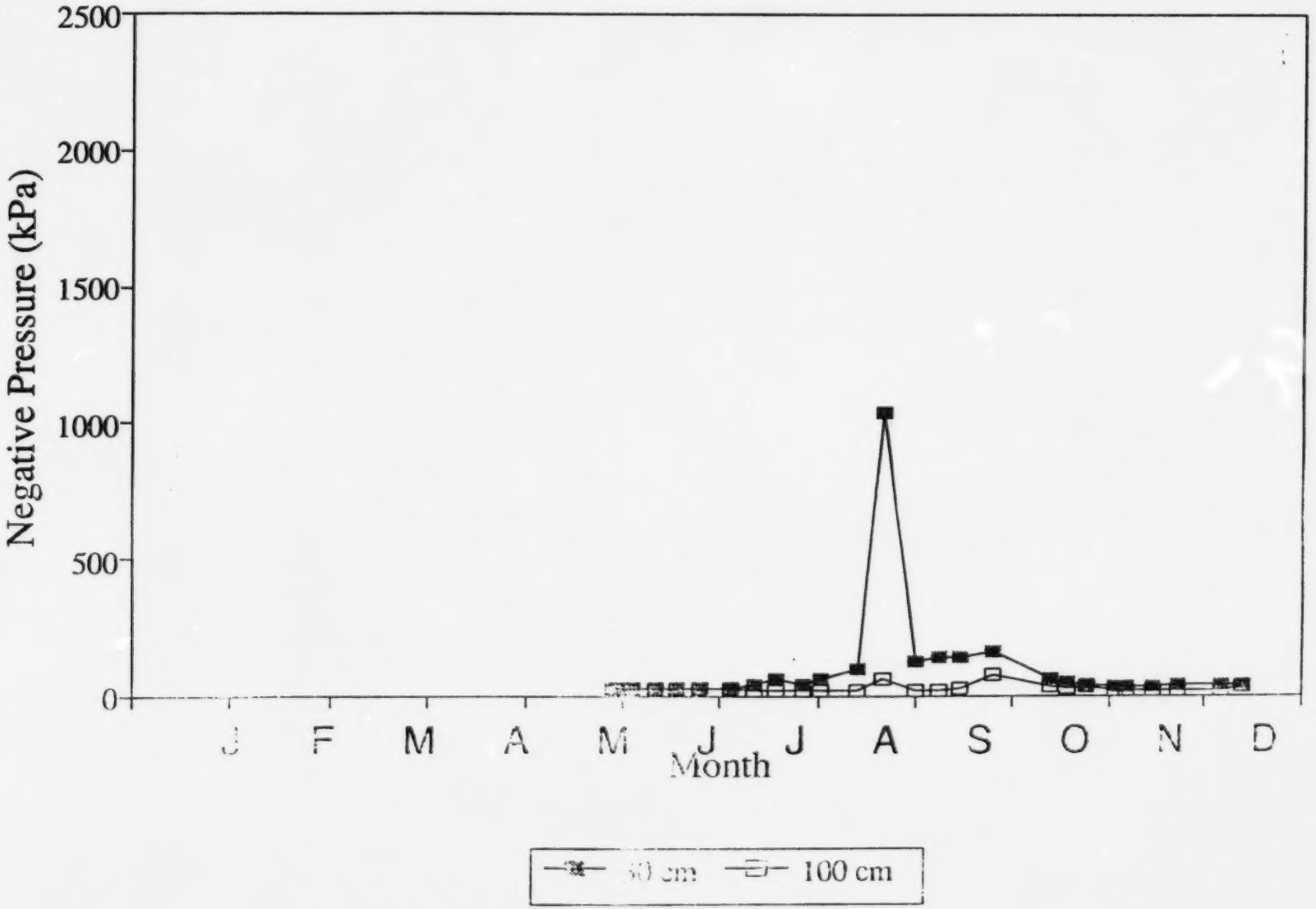
KTB2 Soil Moisture Data 1989
Matric Potential at 2 Depths



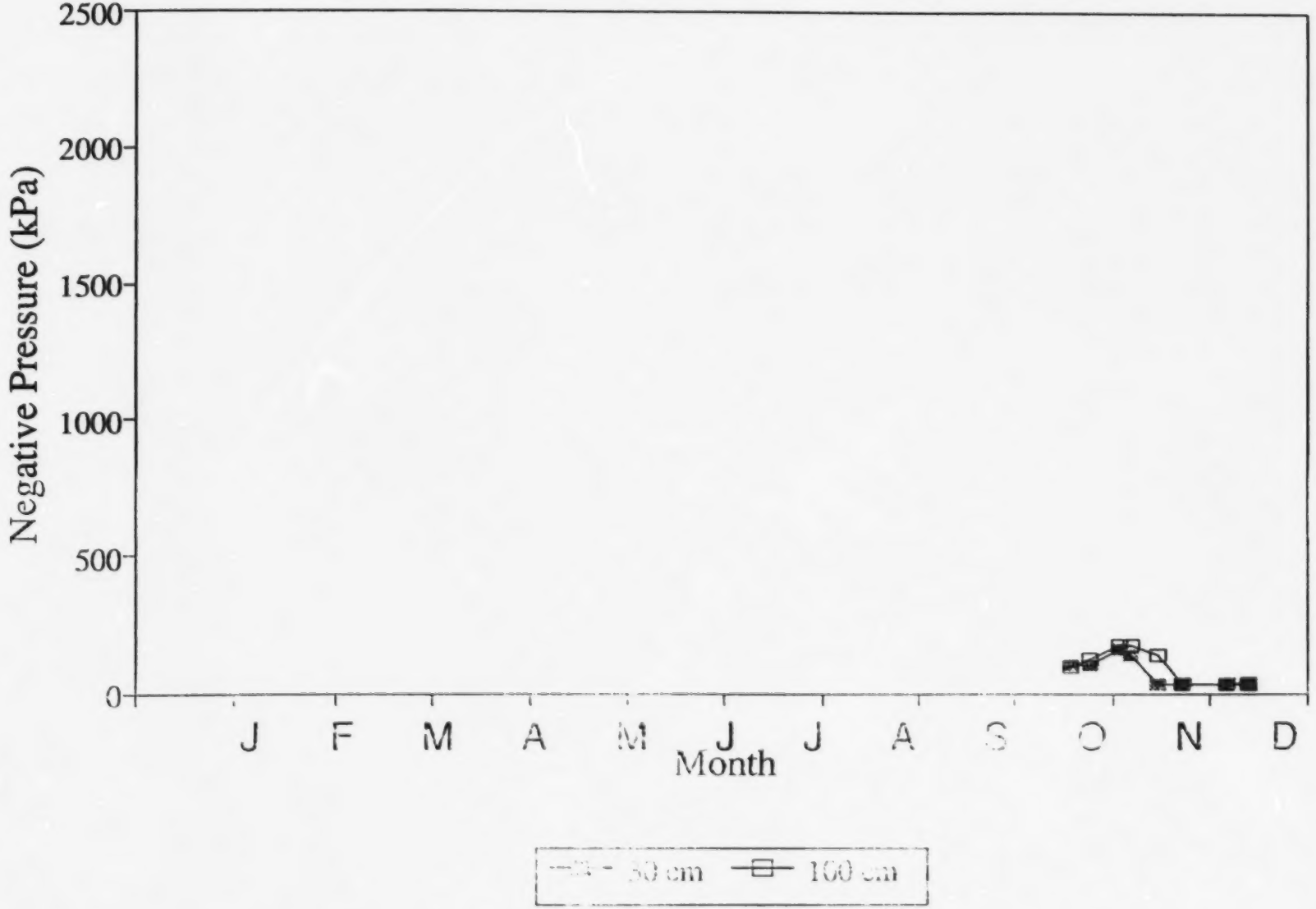
PCB1 Soil Moisture Data 1989
Matric Potential at 2 Depths



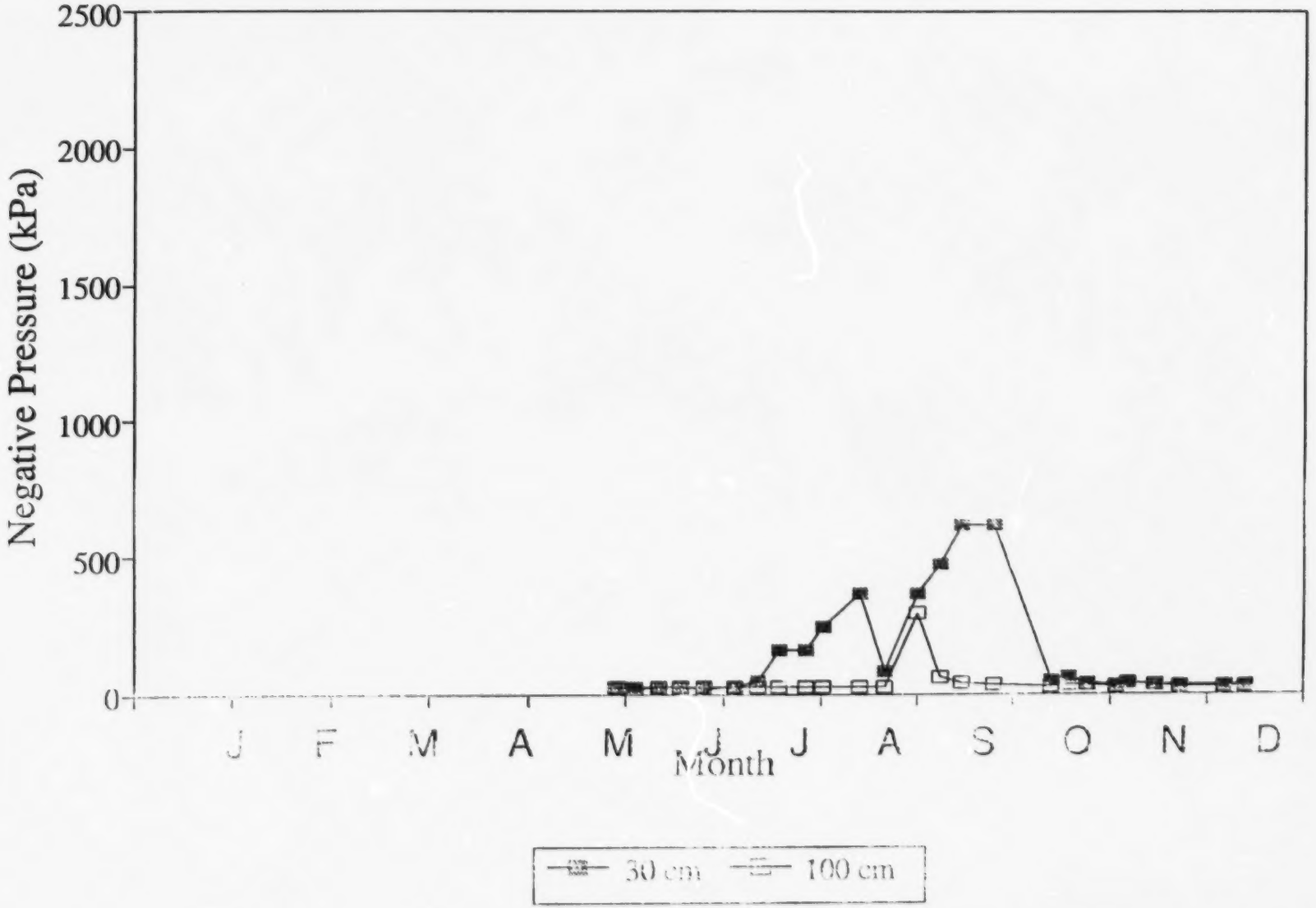
PCB2 Soil Moisture Data 1989
Matric Potential at 2 Depths

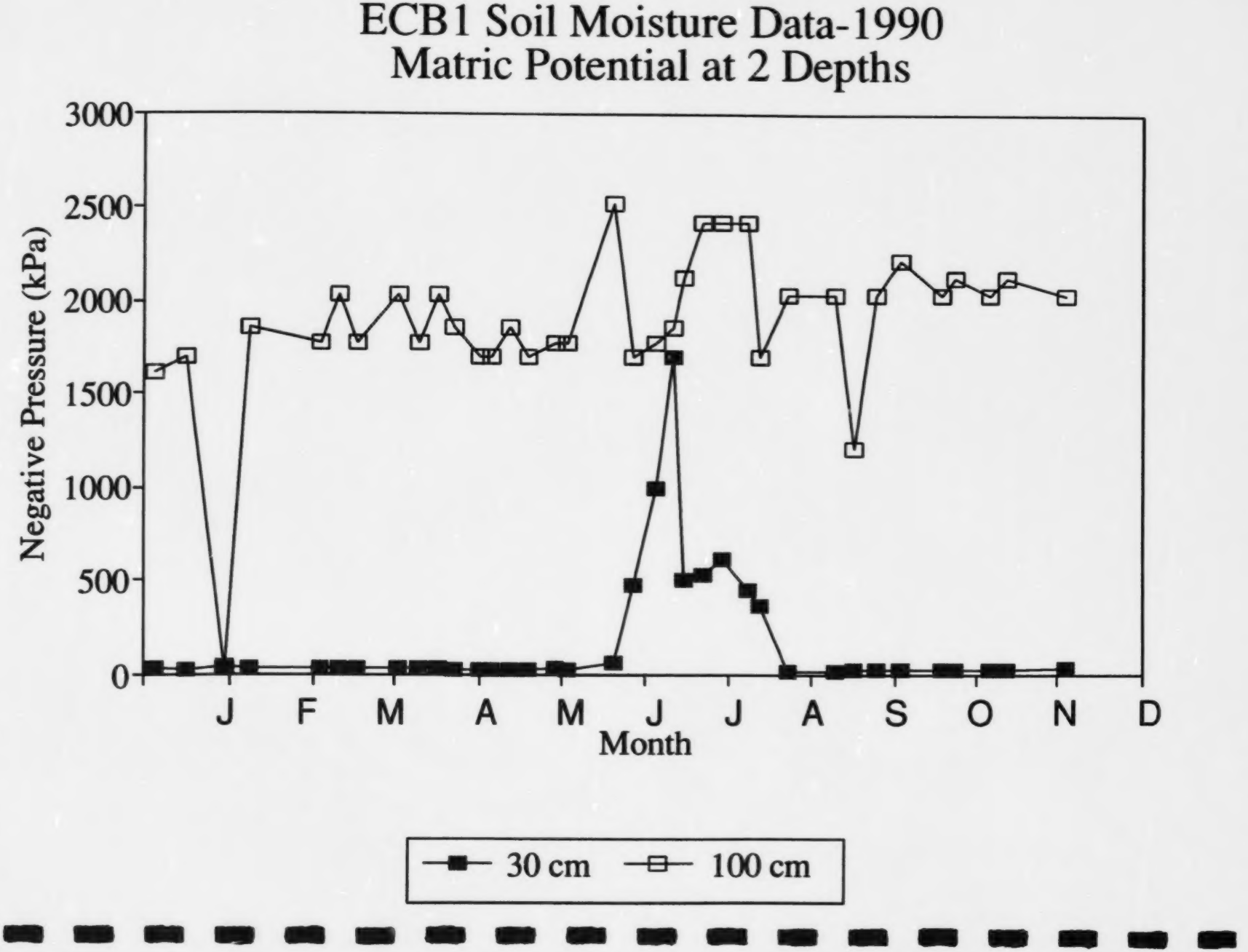


PTB1 Soil Moisture Data 1989
Matric Potential at 2 Depths

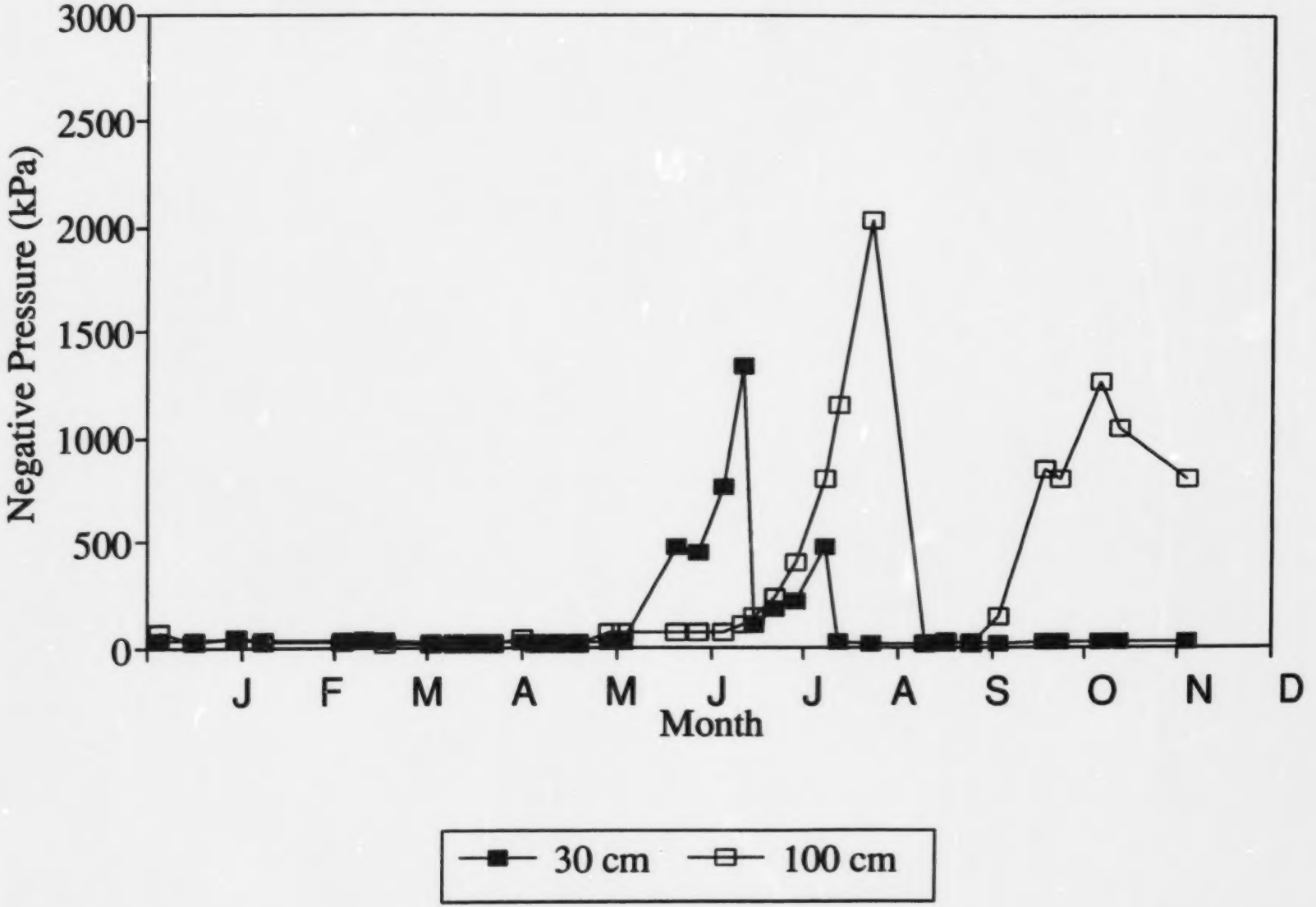


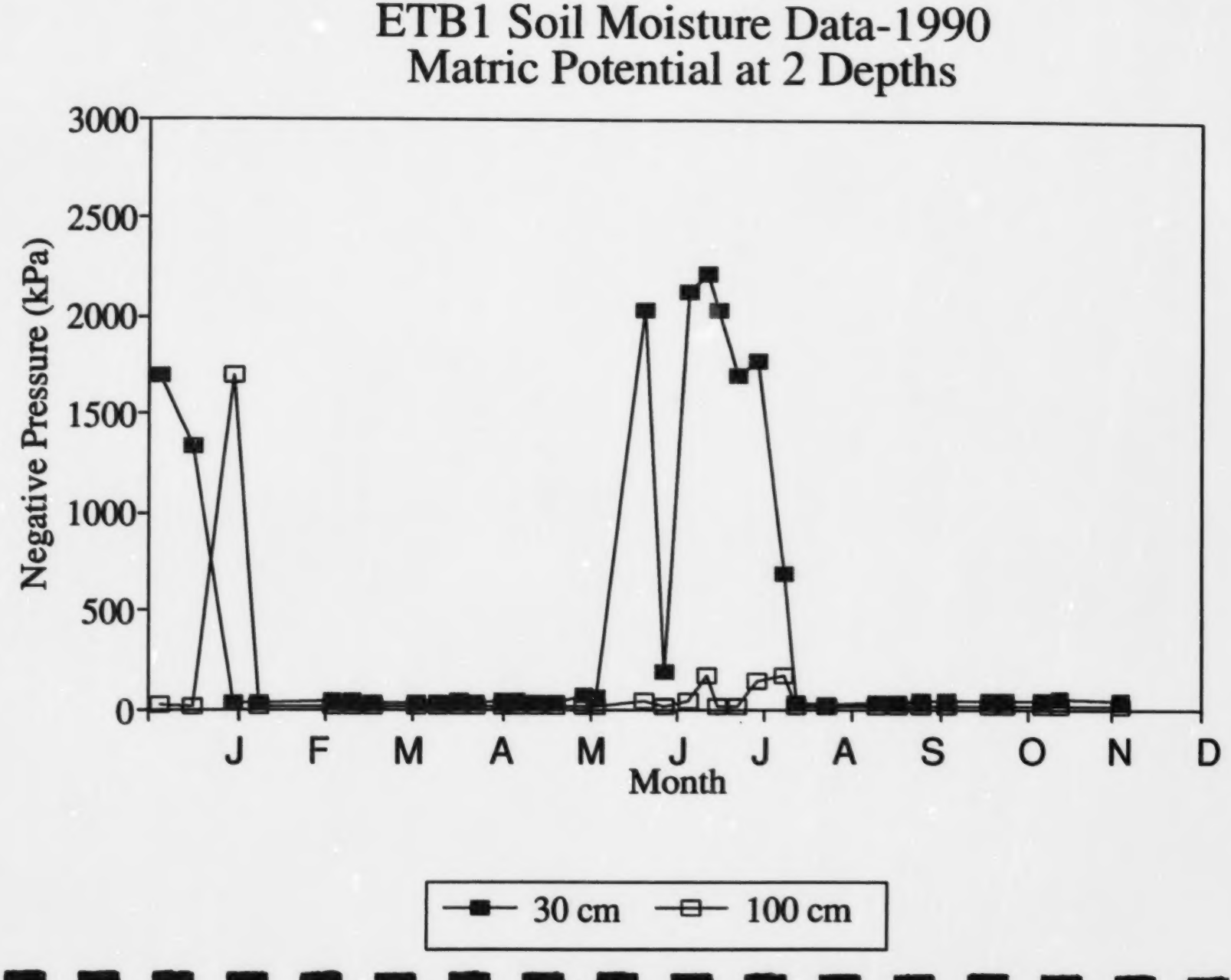
PTB2 Soil Moisture Data 1989
Matric Potential at 2 Depths

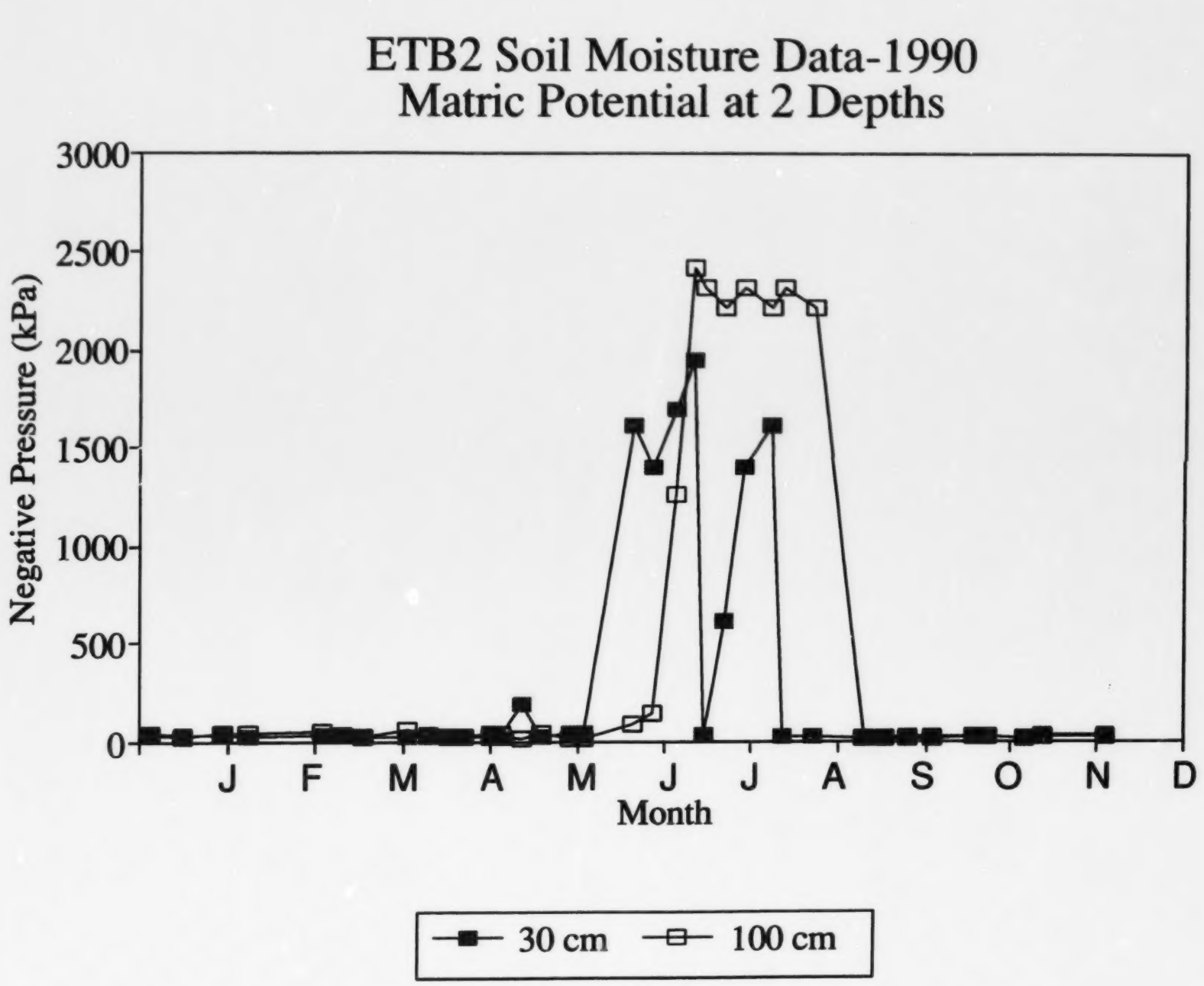


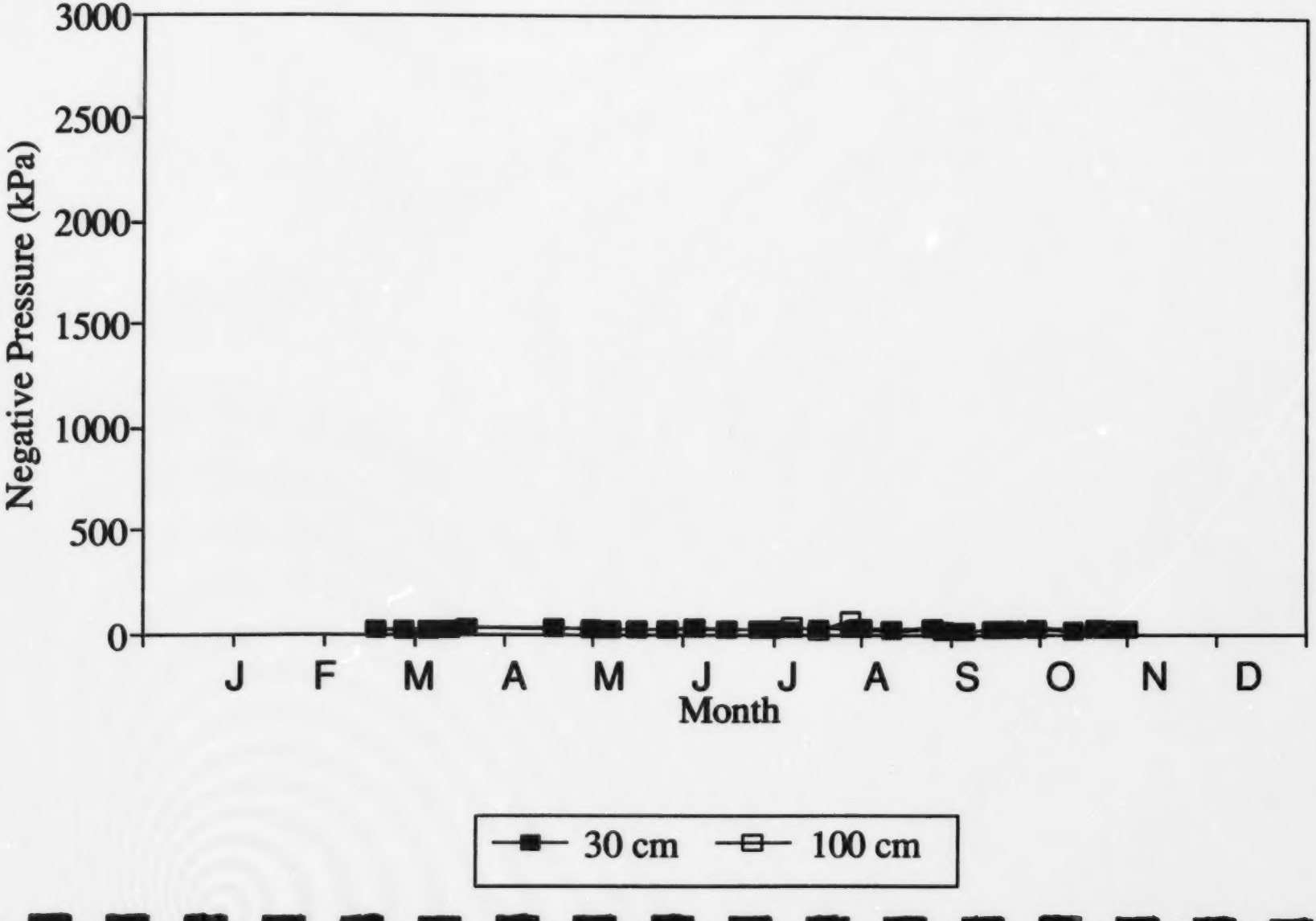

ECB1 Soil Moisture Data-1990
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

ECB2 Soil Moisture Data-1990
Matric Potential at 2 Depths

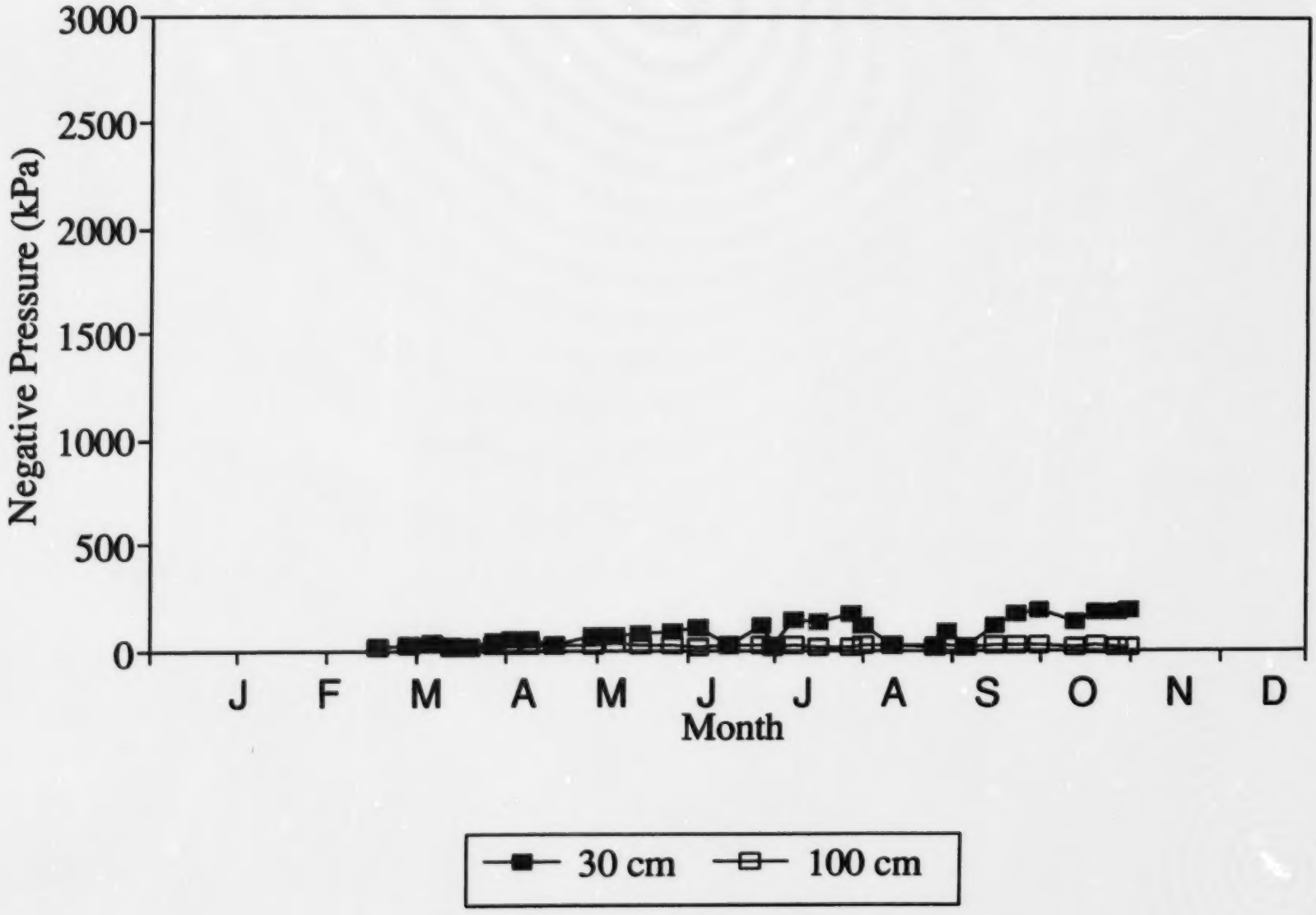


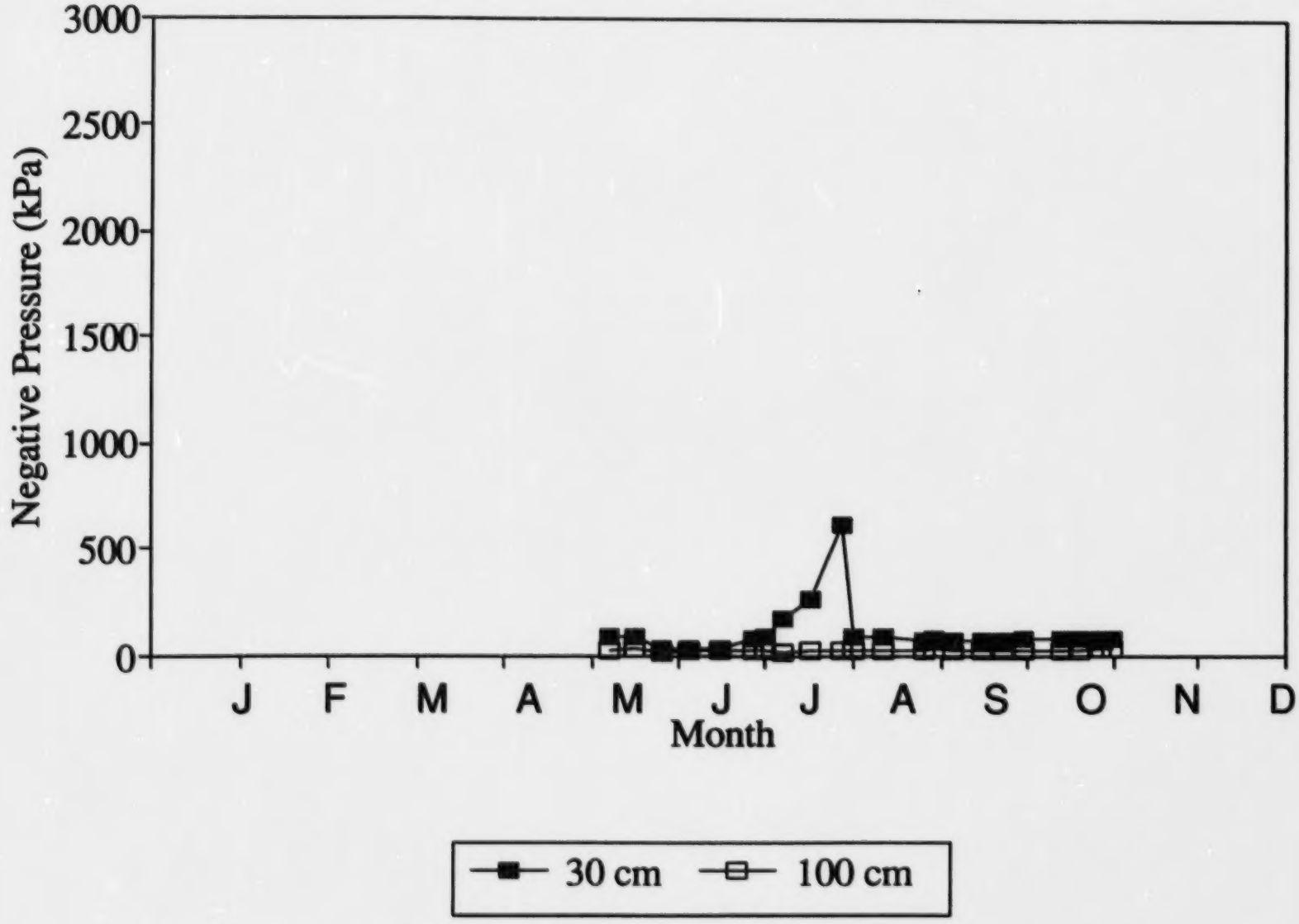

ETB1 Soil Moisture Data-1990
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm


ETB2 Soil Moisture Data-1990
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

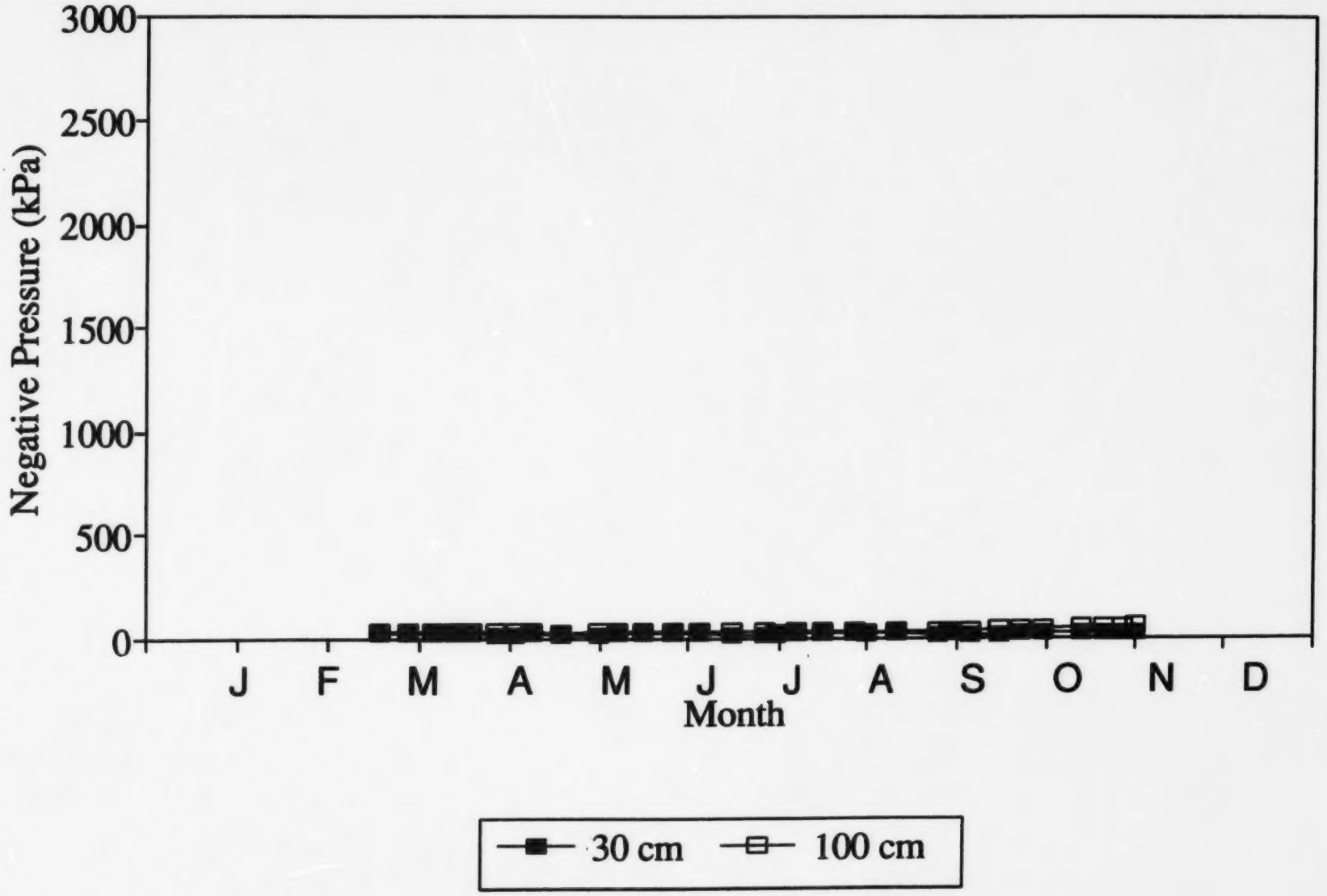

KCB1 Soil Moisture Data-1990
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

KCB2 Soil Moisture Data-1990
Matric Potential at 2 Depths

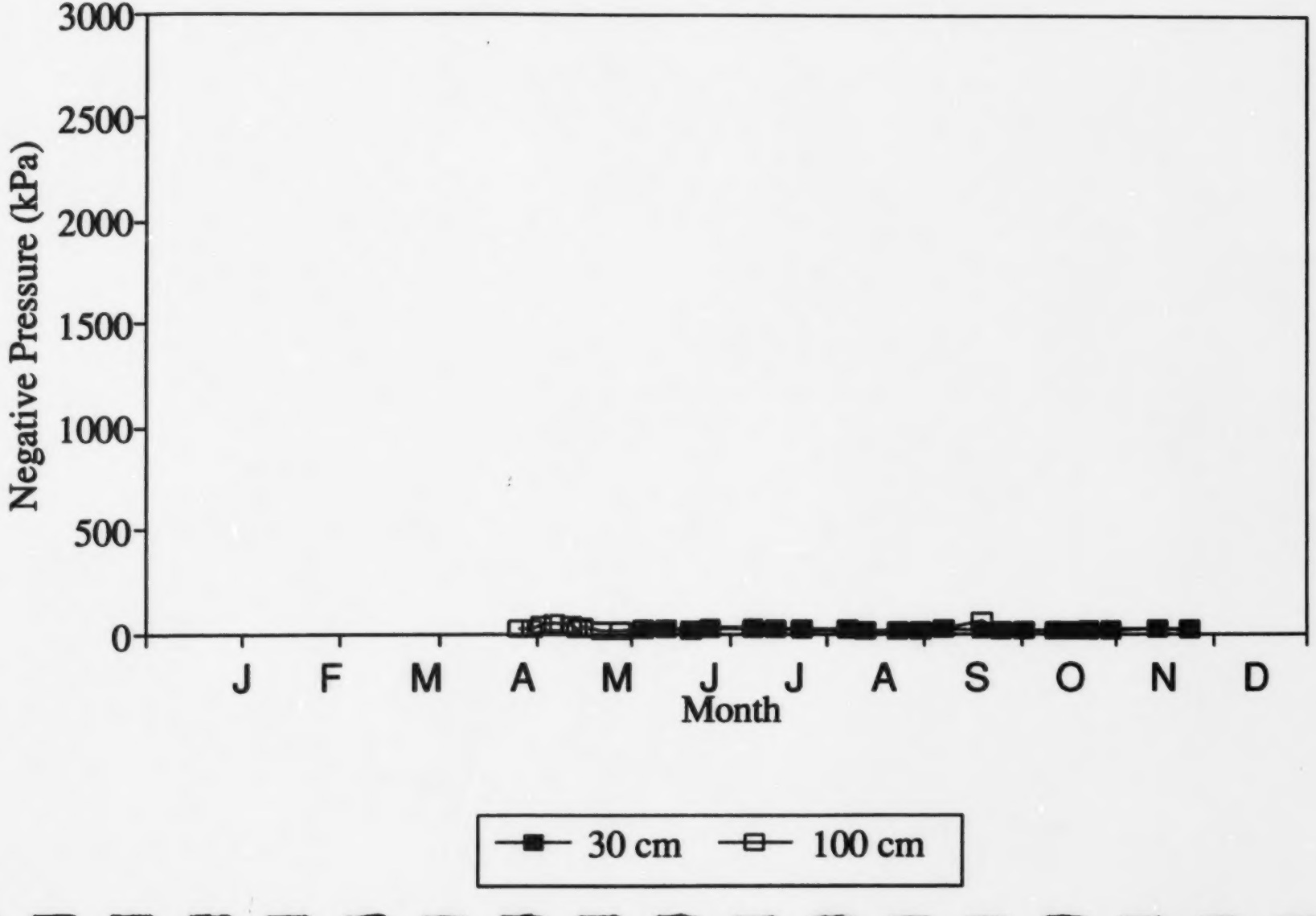


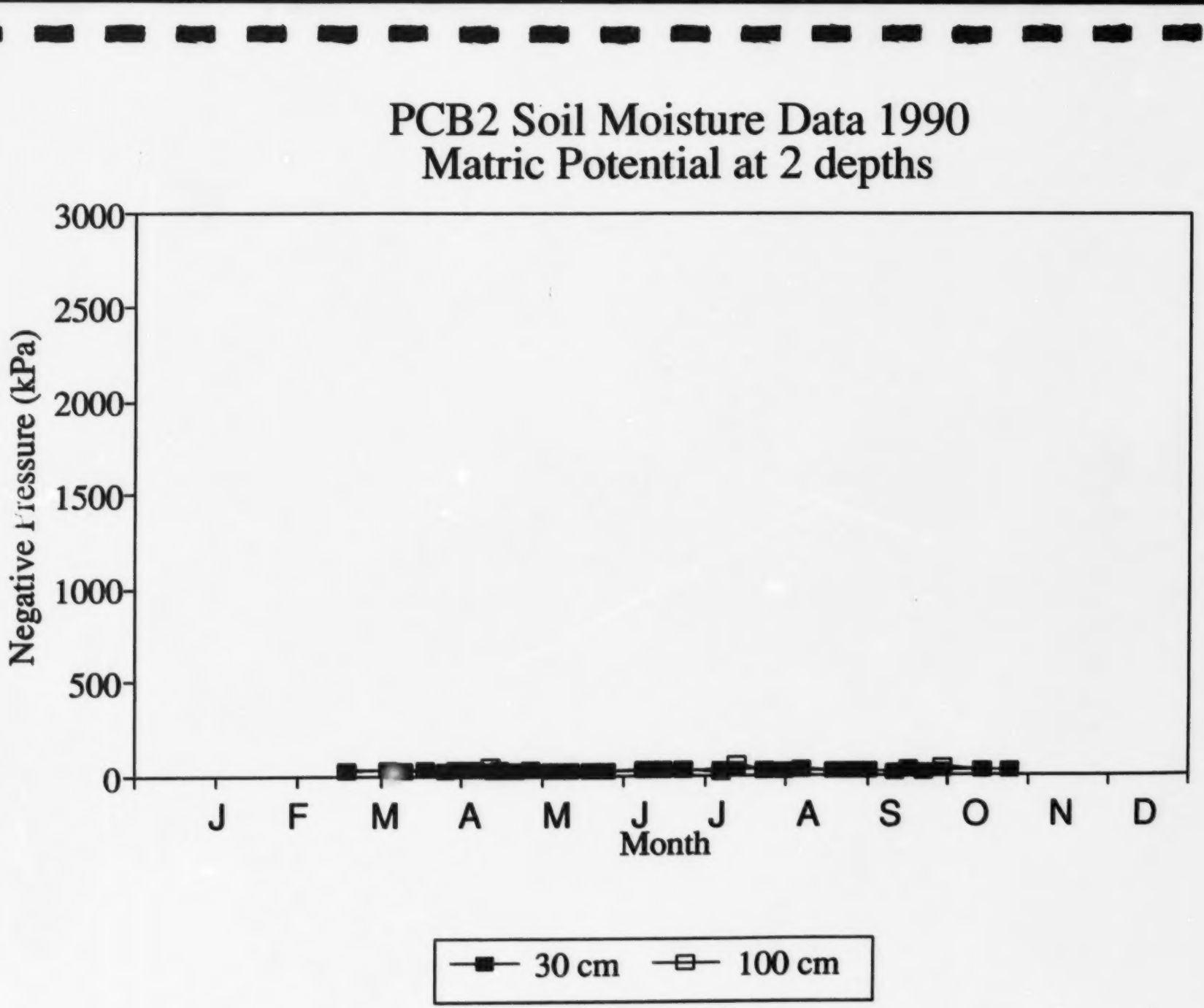

KTB2 Soil Moisture Data-1990
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

KTB1 Soil Moisture Data-1990
Matric Potential at 2 Depths

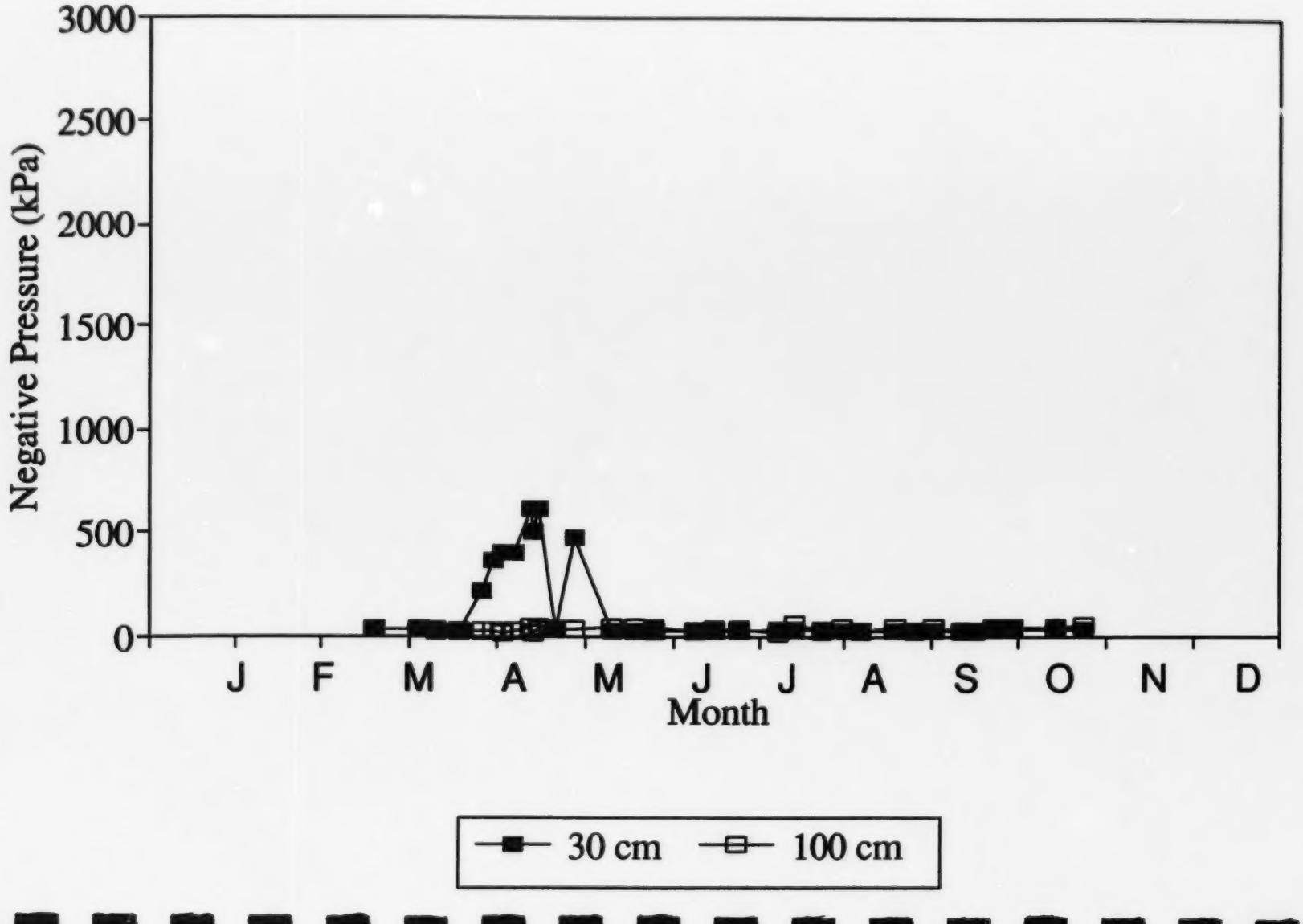


PCB1 Soil Moisture Data 1990
Matric Potential at 2 depths

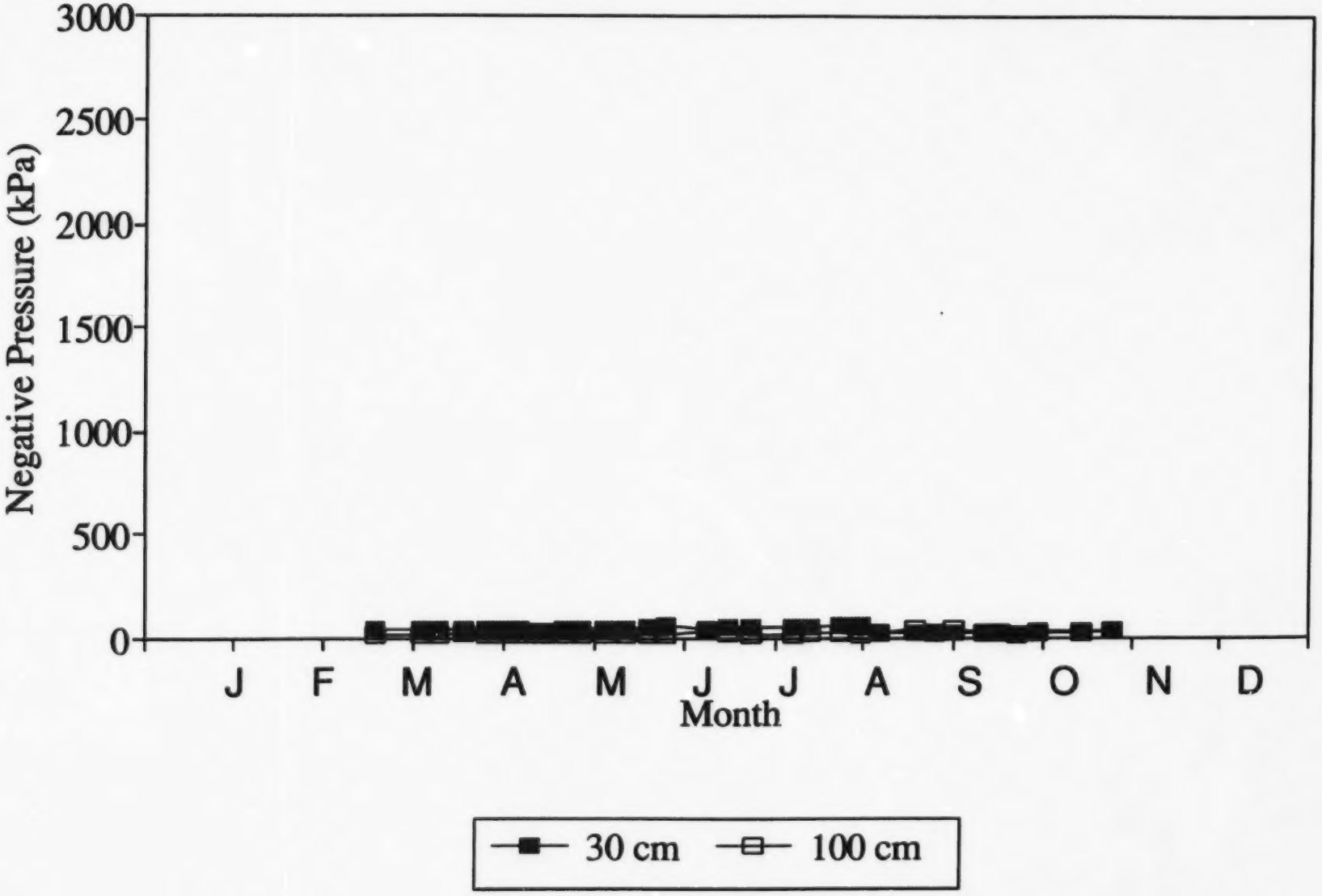


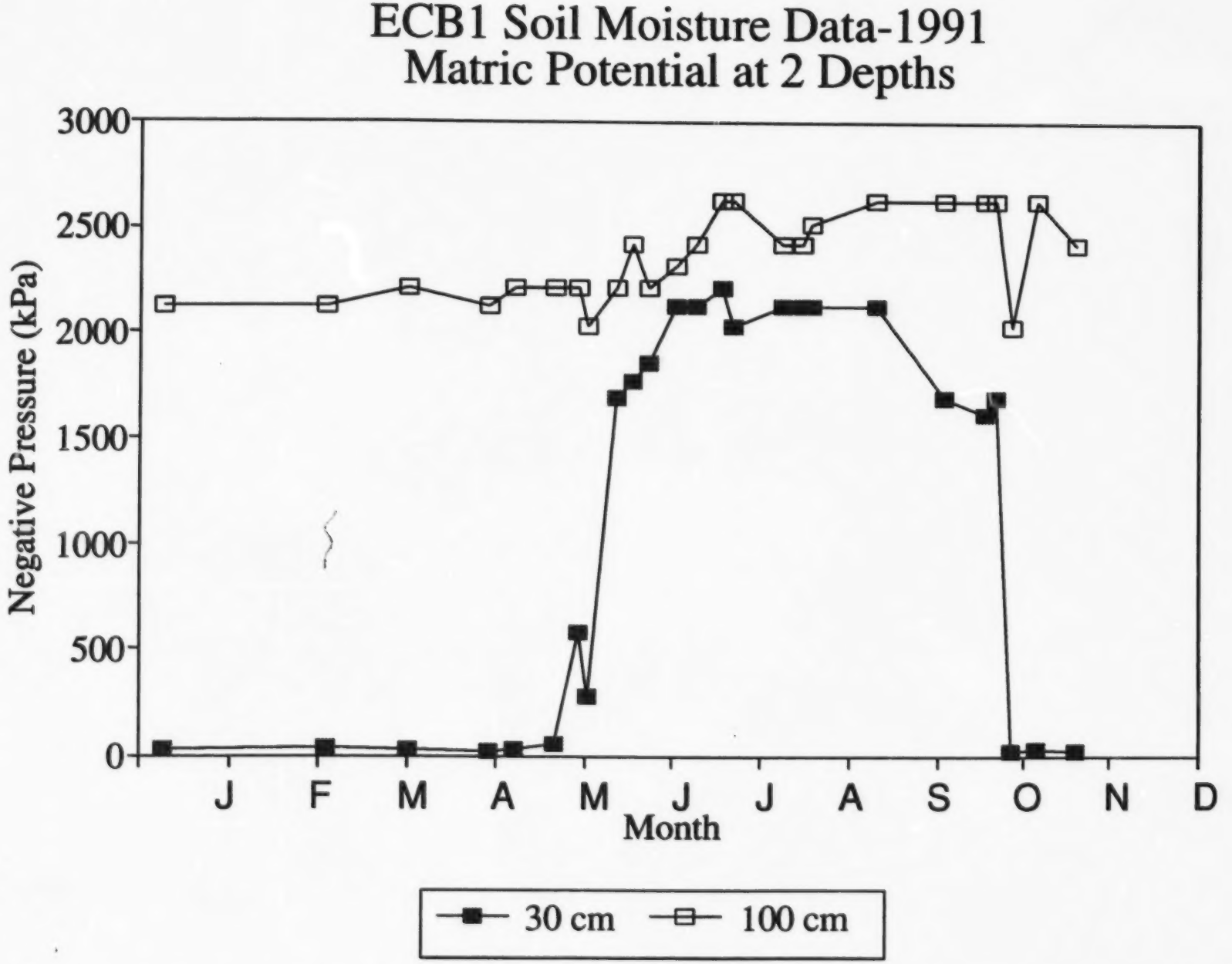

PCB2 Soil Moisture Data 1990
Matric Potential at 2 depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

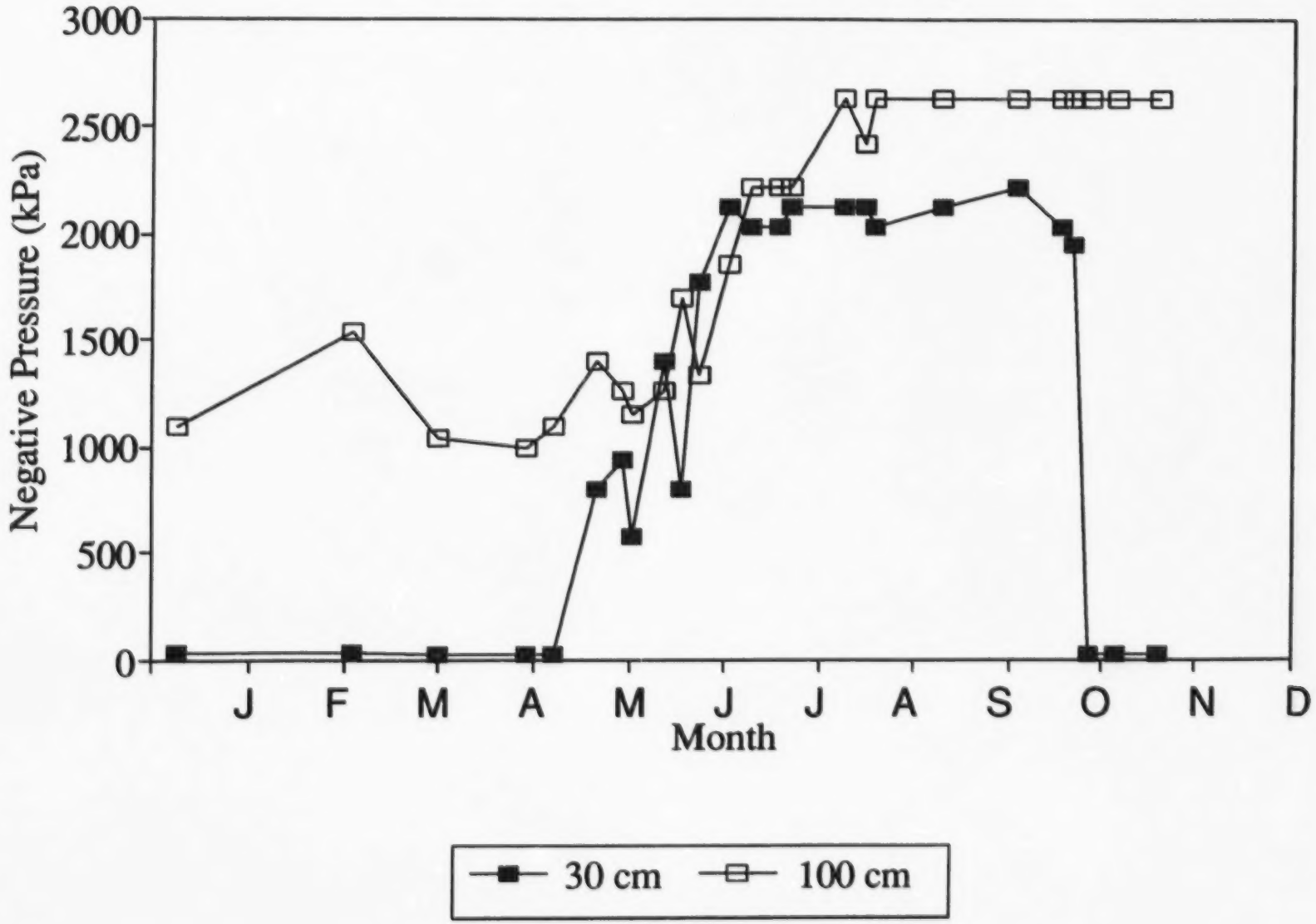
PTB1 Soil Moisture Data 1990
Matric Potential at 2 depths

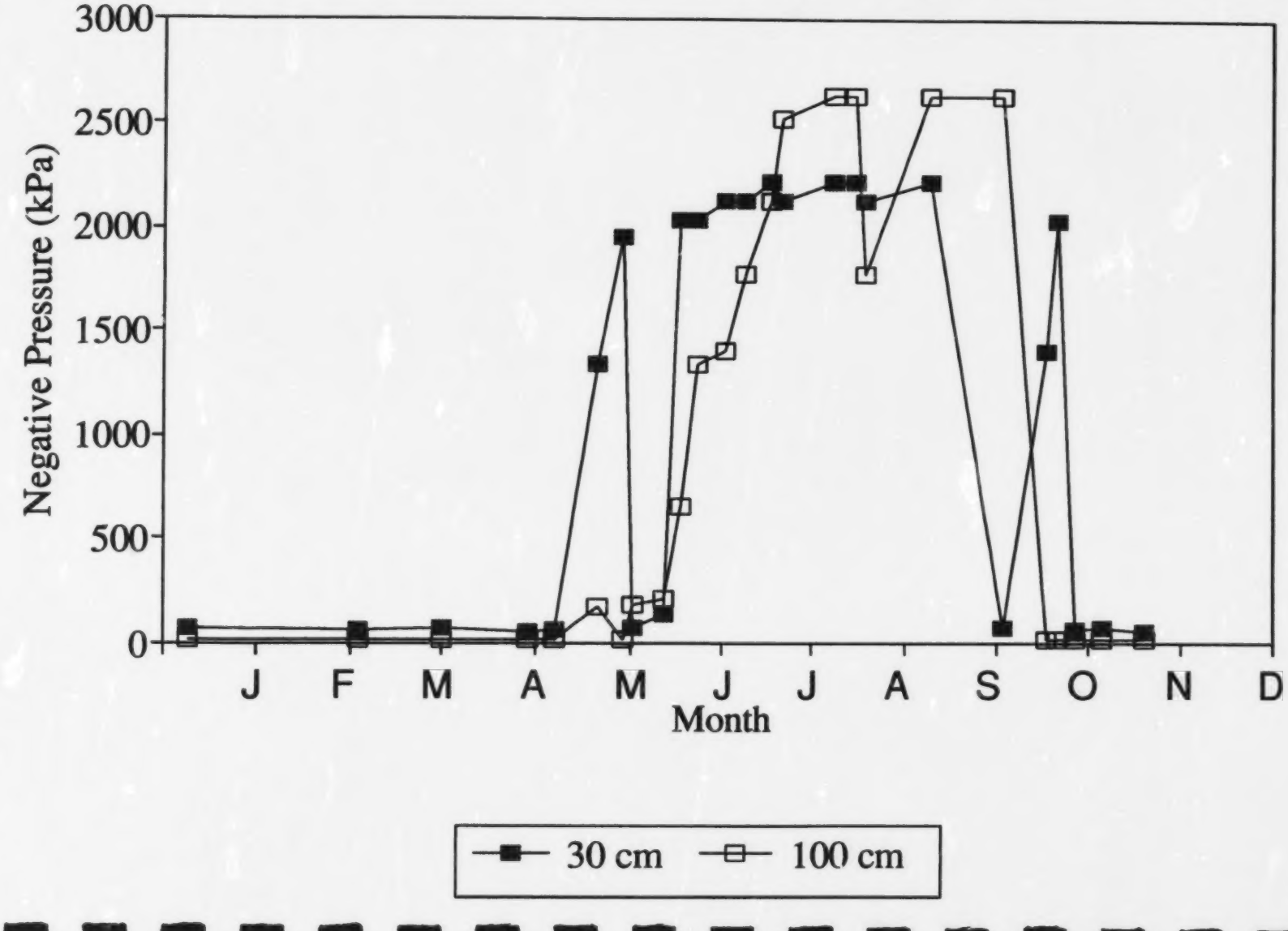


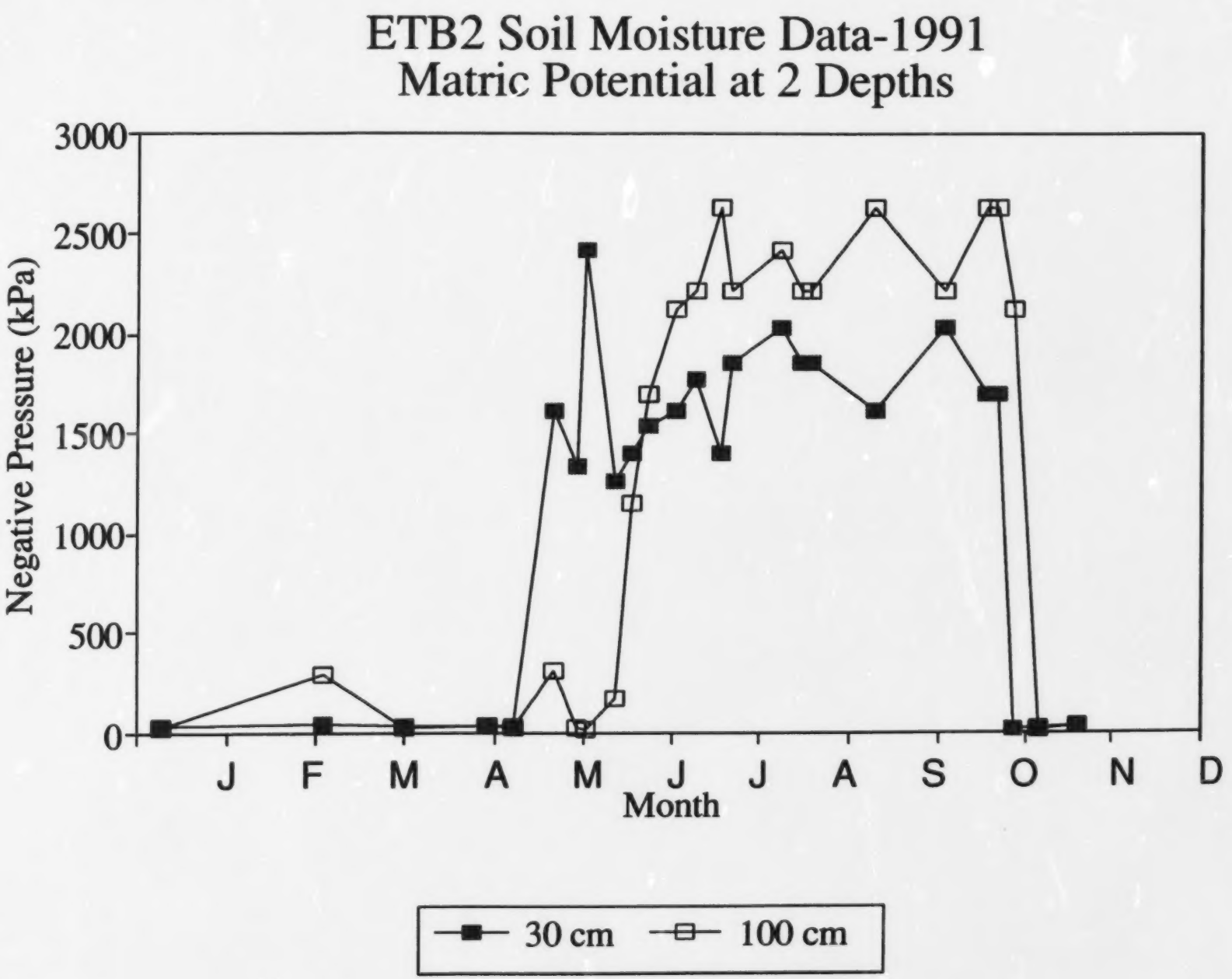
PTB2 Soil Moisture Data 1990
Matric Potential at 2 depths

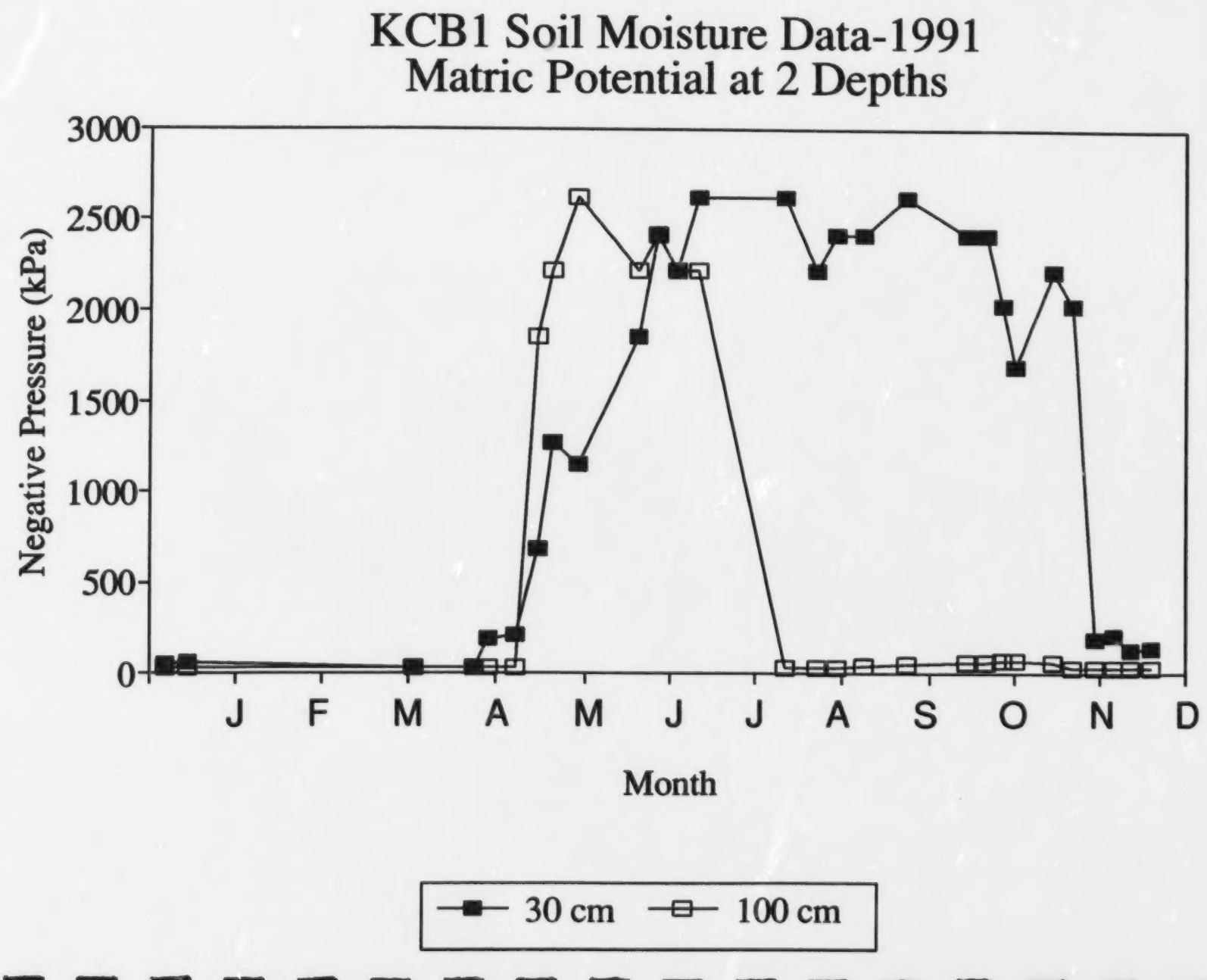


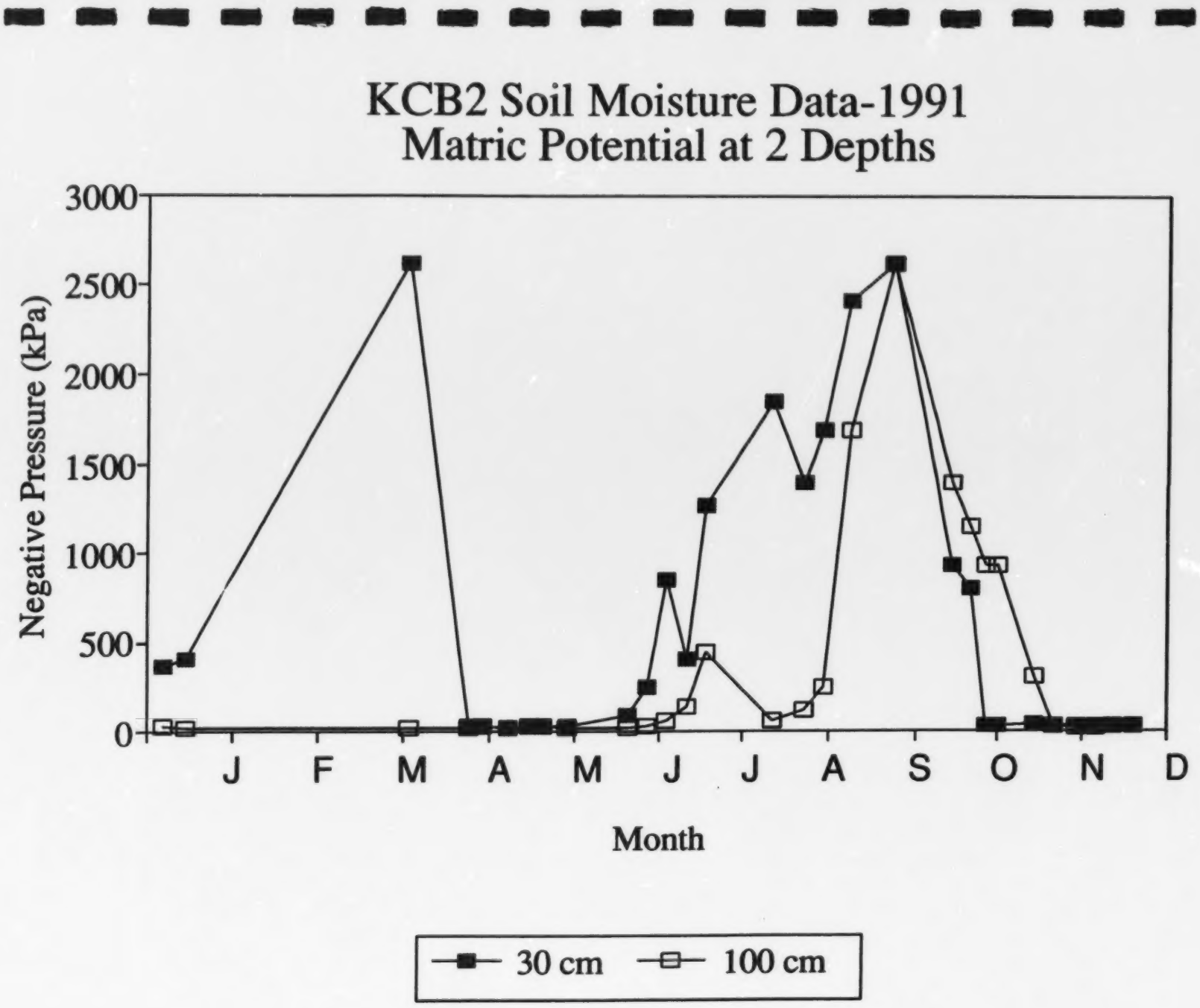

ECB1 Soil Moisture Data-1991
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

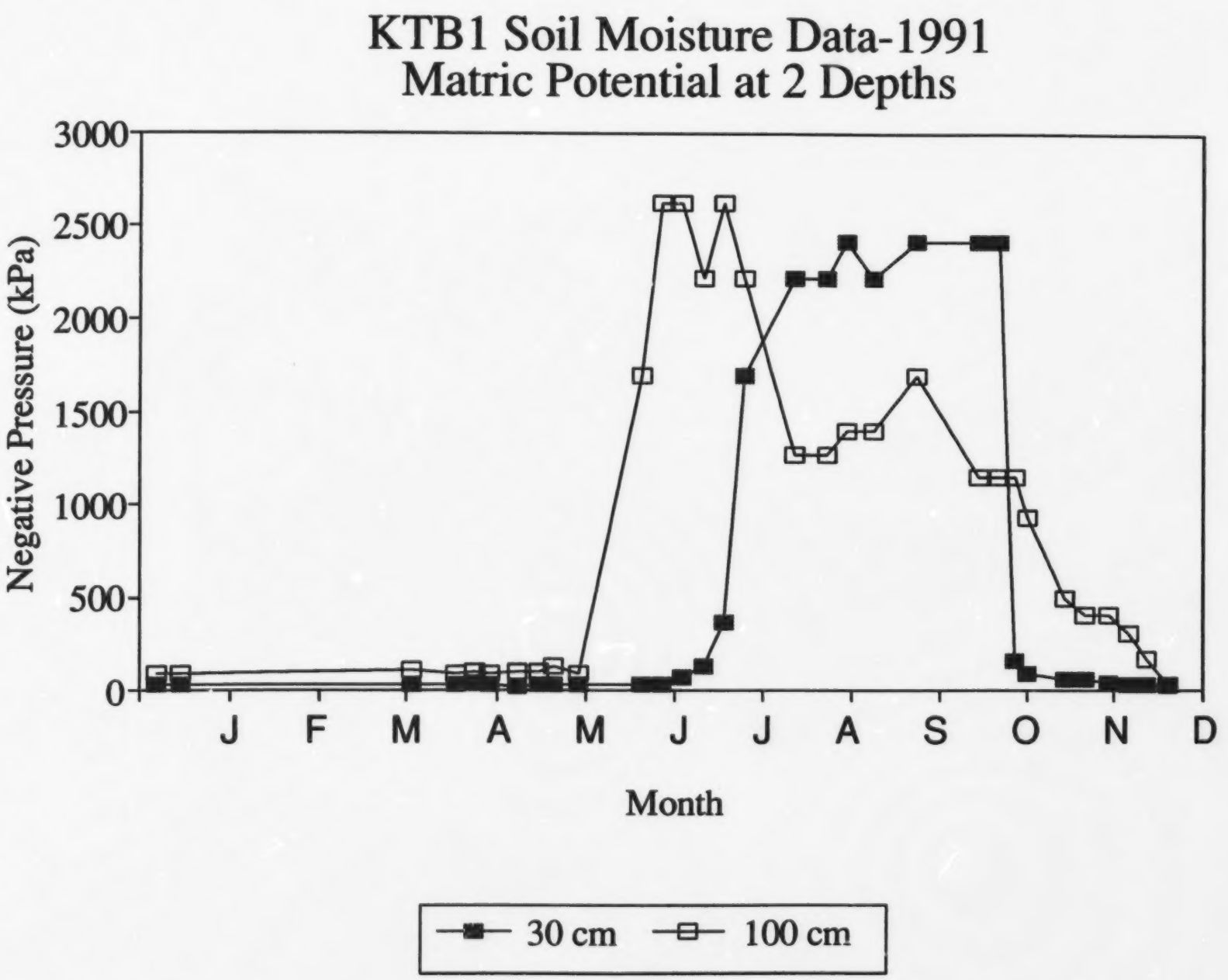

ECB2 Soil Moisture Data-1991
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm


ETB1 Soil Moisture Data-1991
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

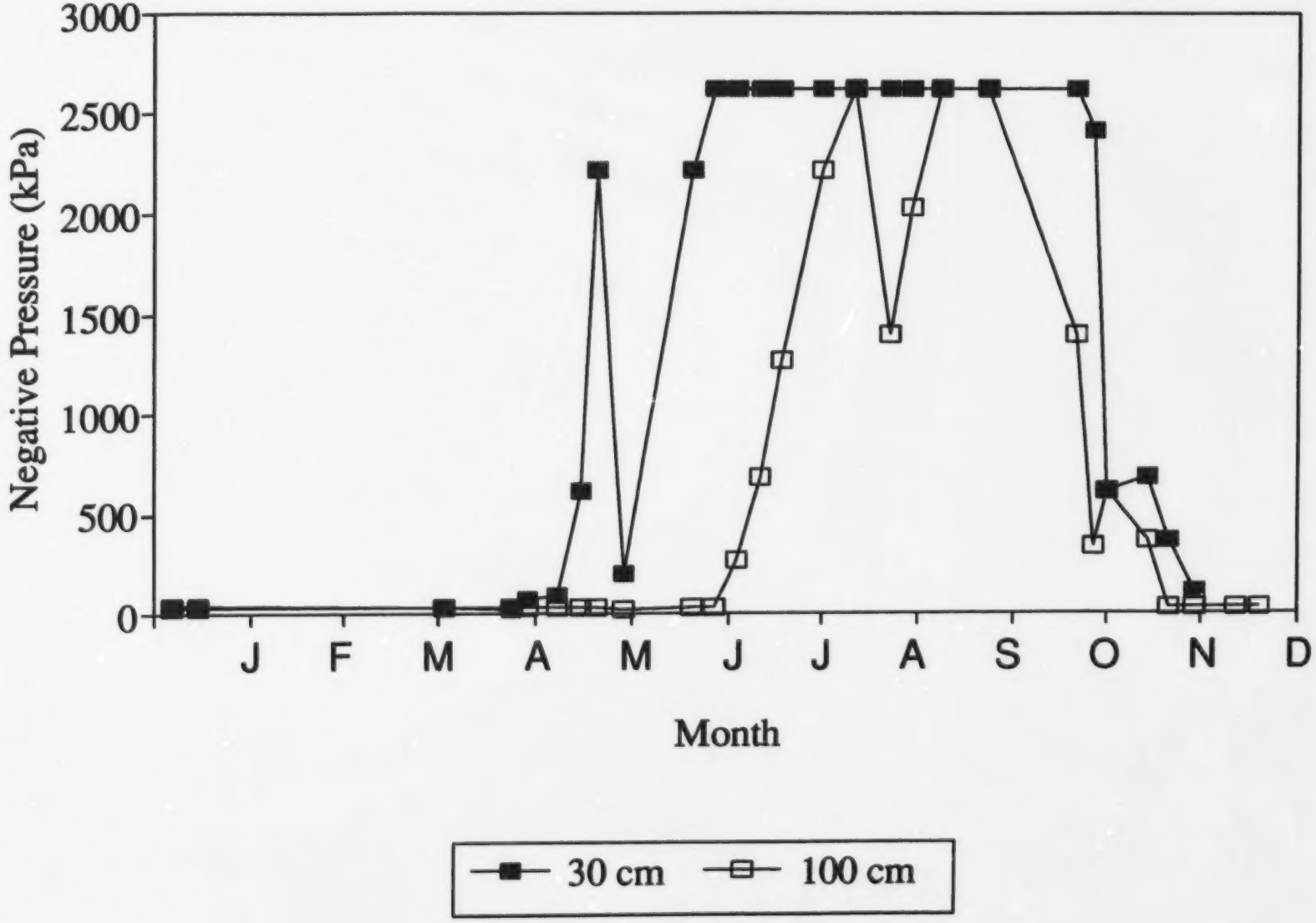

ETB2 Soil Moisture Data-1991
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm


KCB1 Soil Moisture Data-1991
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

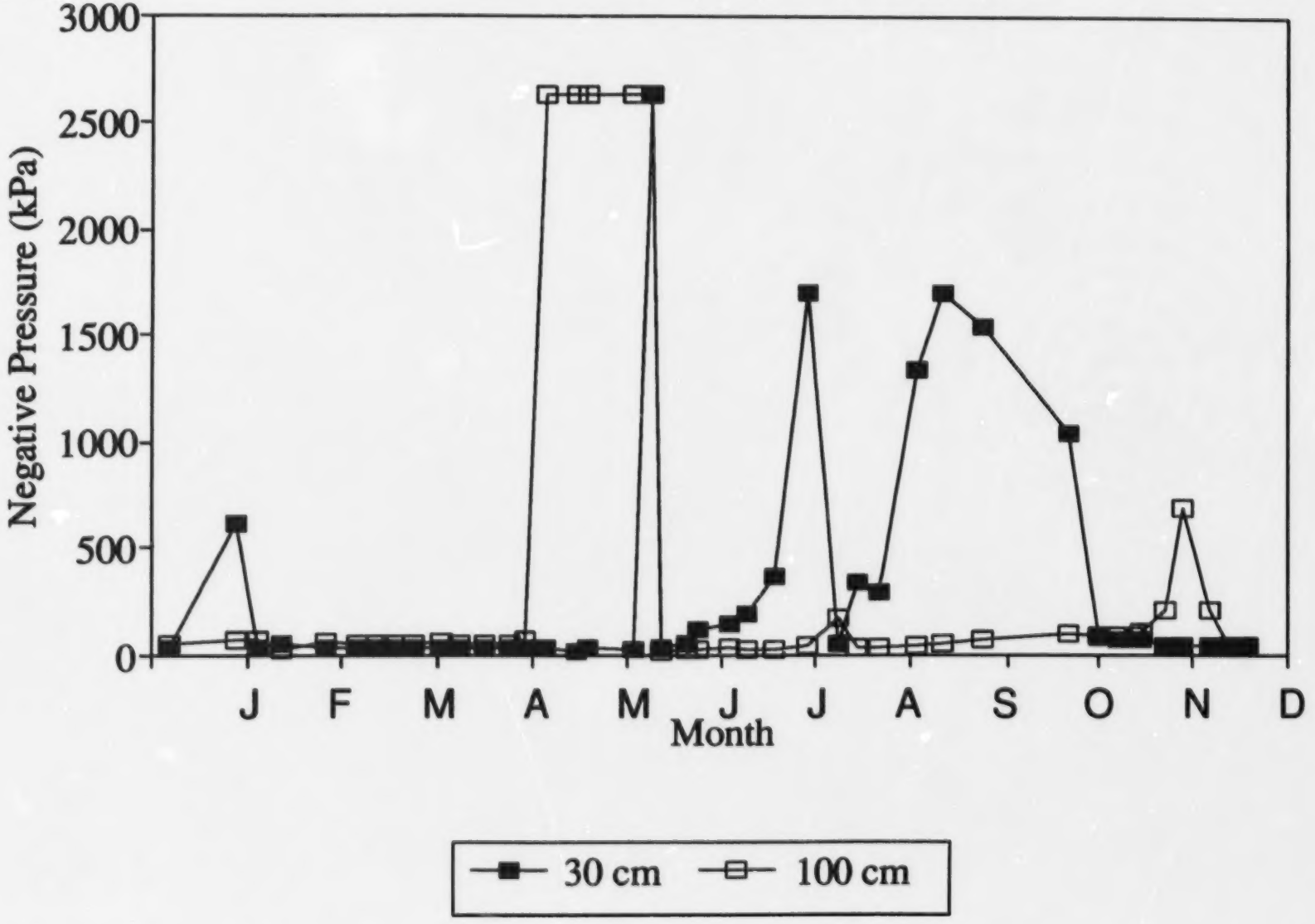

KCB2 Soil Moisture Data-1991
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

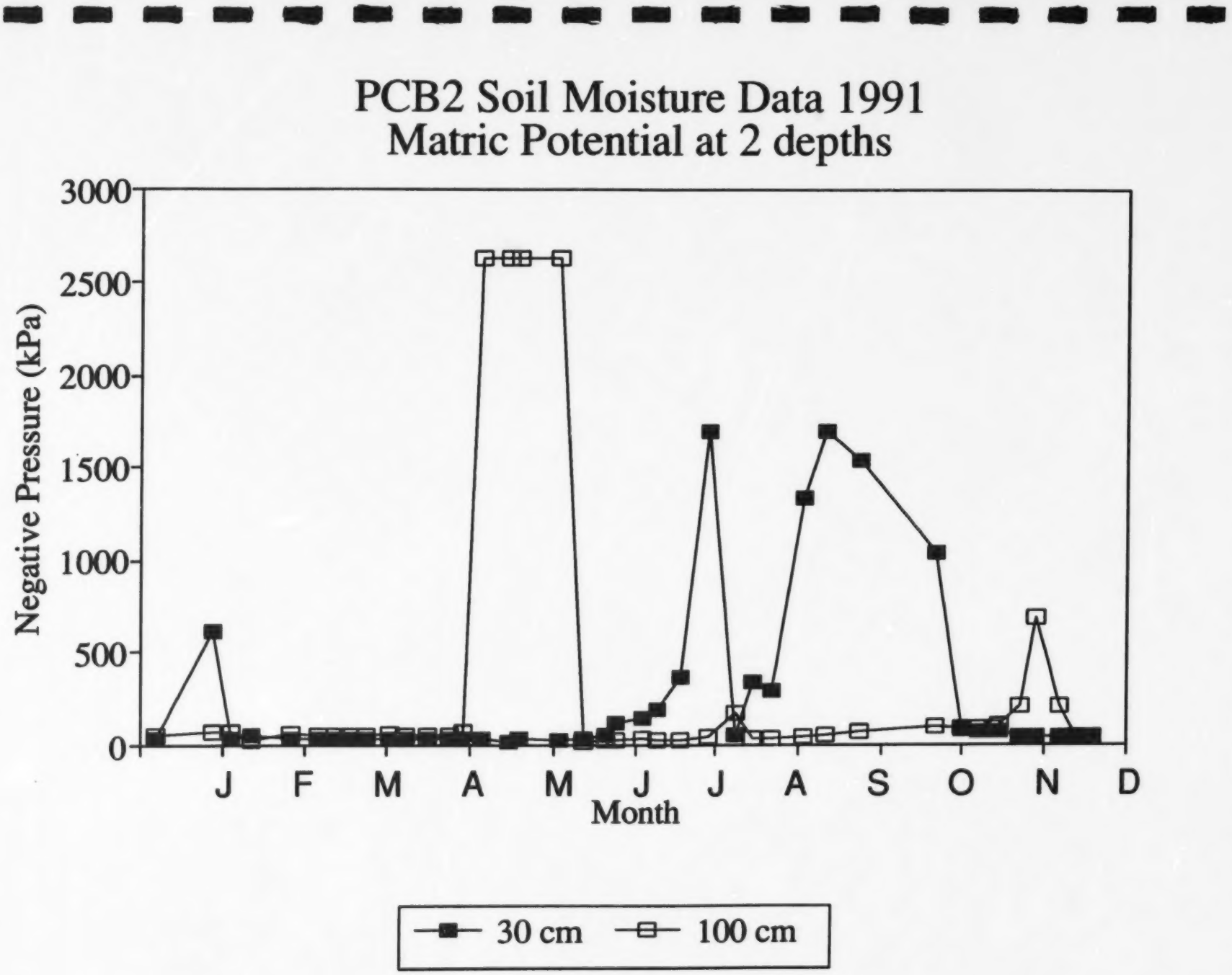

KTB1 Soil Moisture Data-1991
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

KTB2 Soil Moisture Data-1991
Matric Potential at 2 Depths

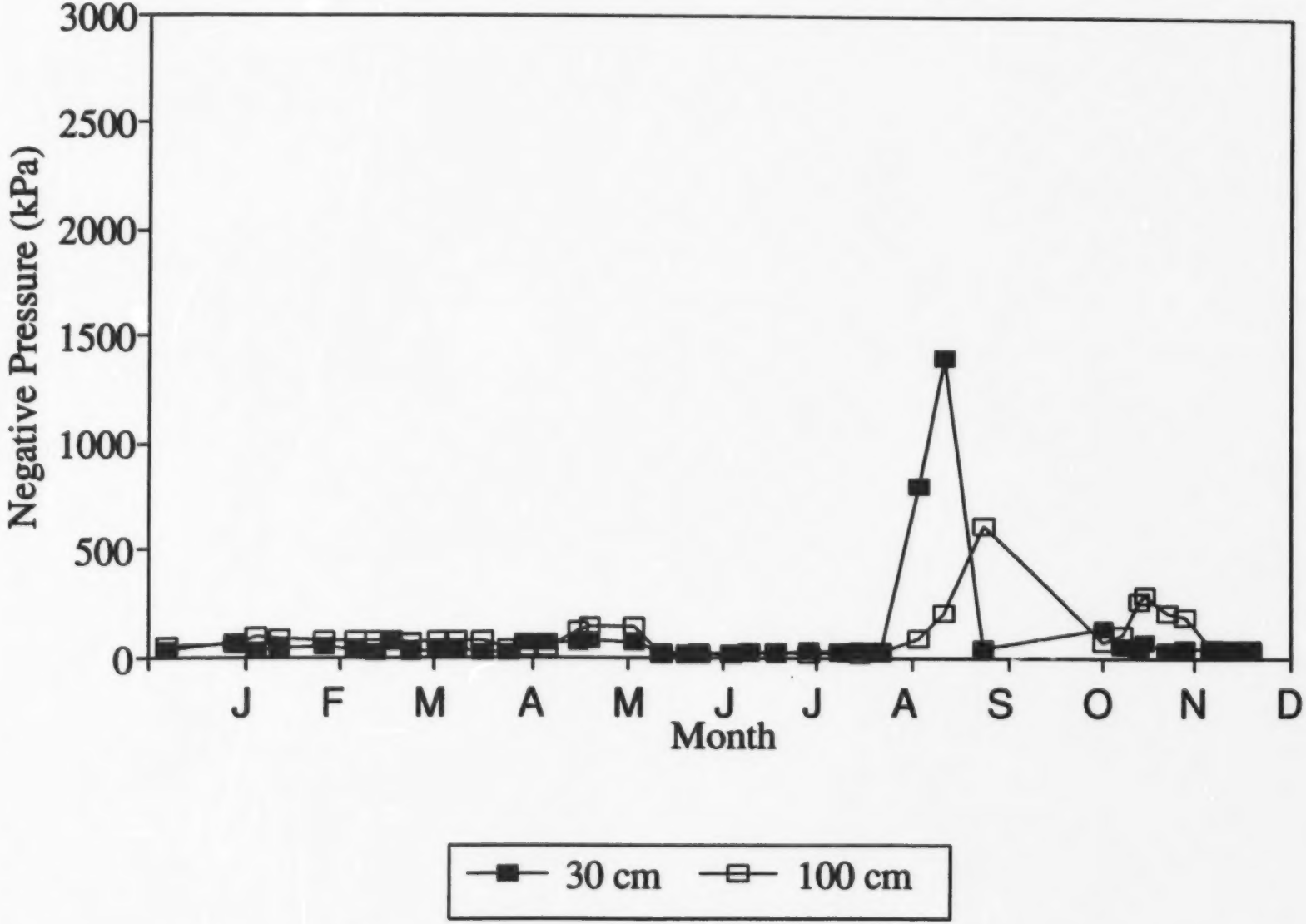


PCB1 Soil Moisture Data 1991
Matric Potential at 2 depths

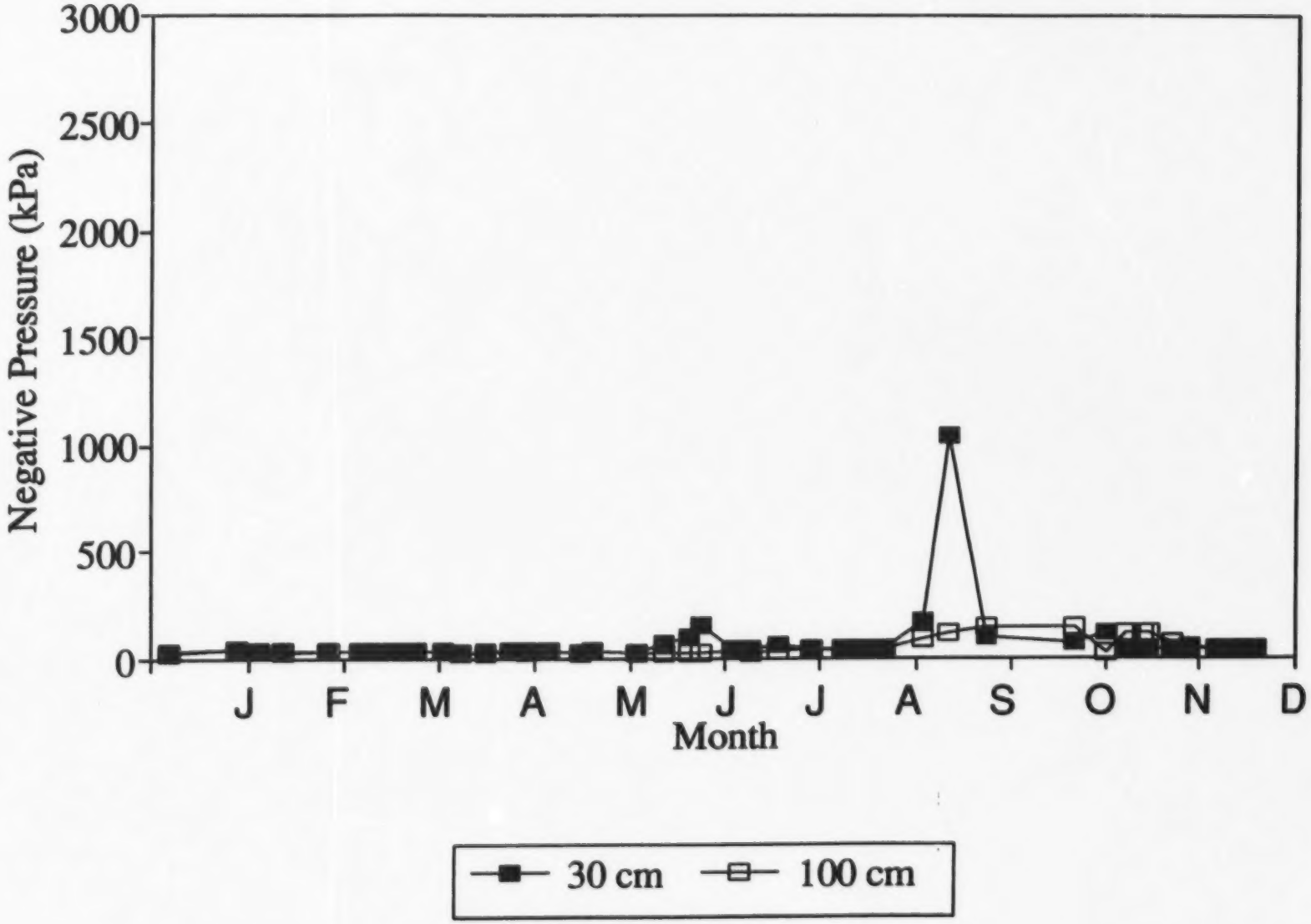


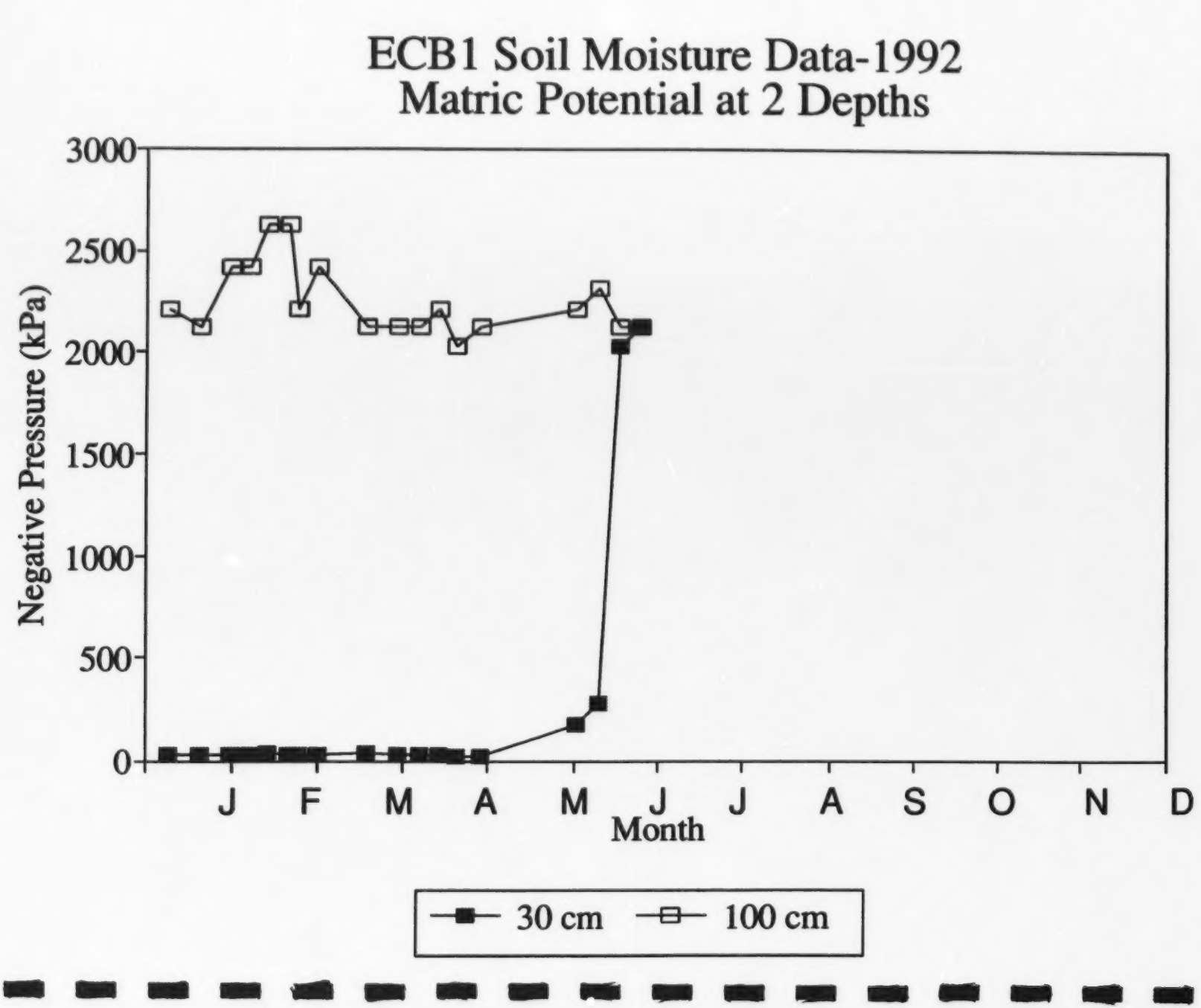

PCB2 Soil Moisture Data 1991
Matric Potential at 2 depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

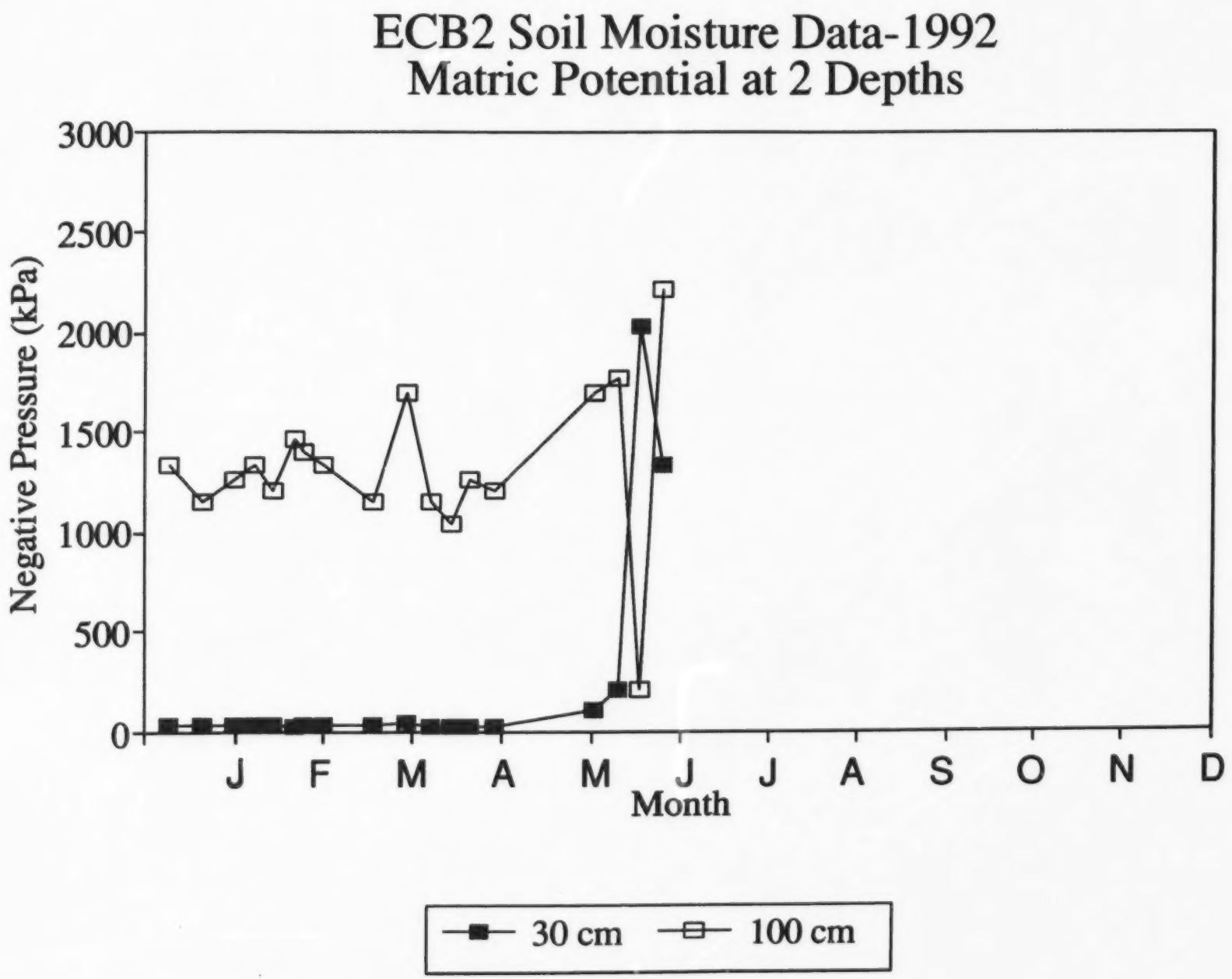
PTB1 Soil Moisture Data 1991
Matric Potential at 2 depths

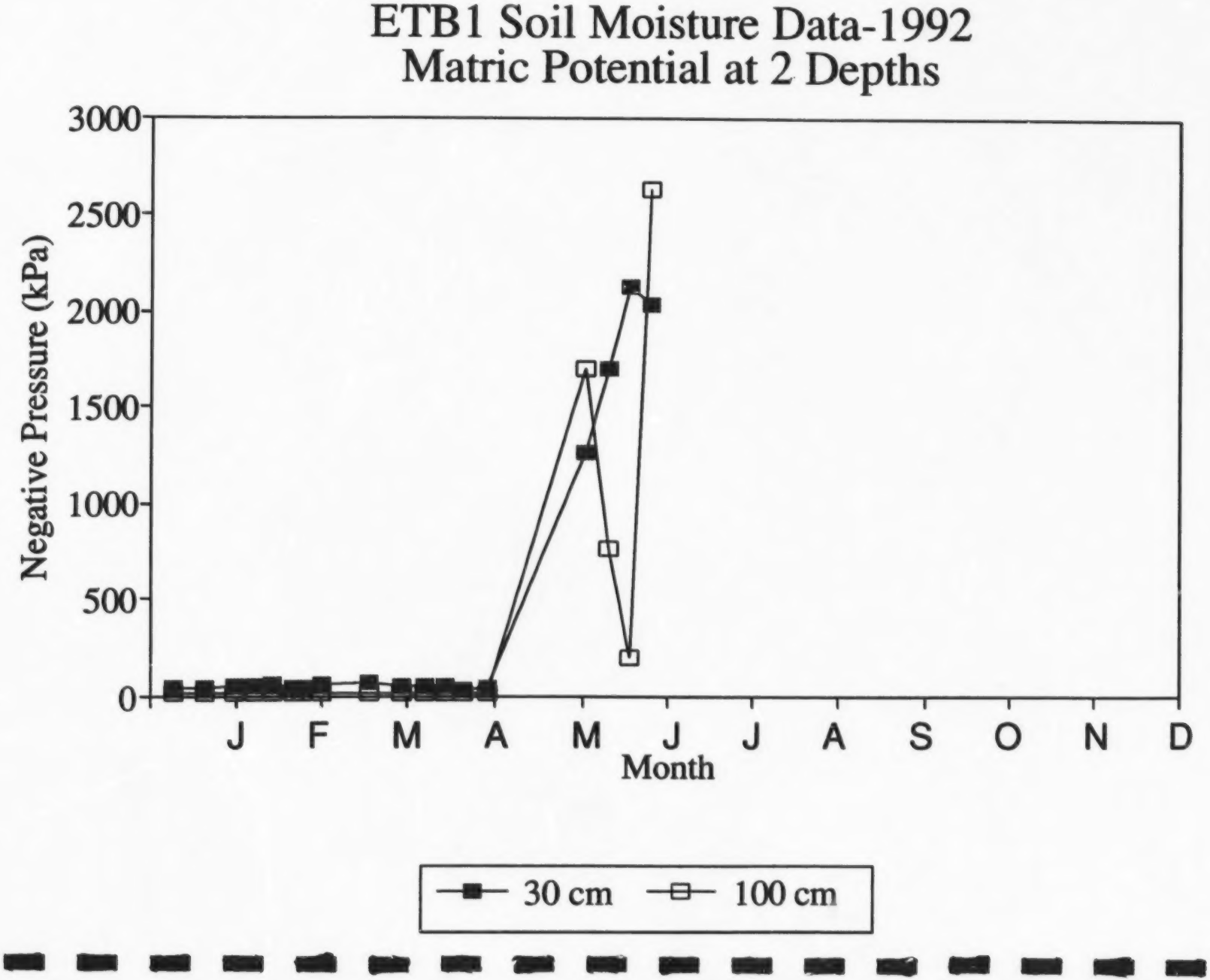


PTB2 Soil Moisture Data 1991
Matric Potential at 2 depths

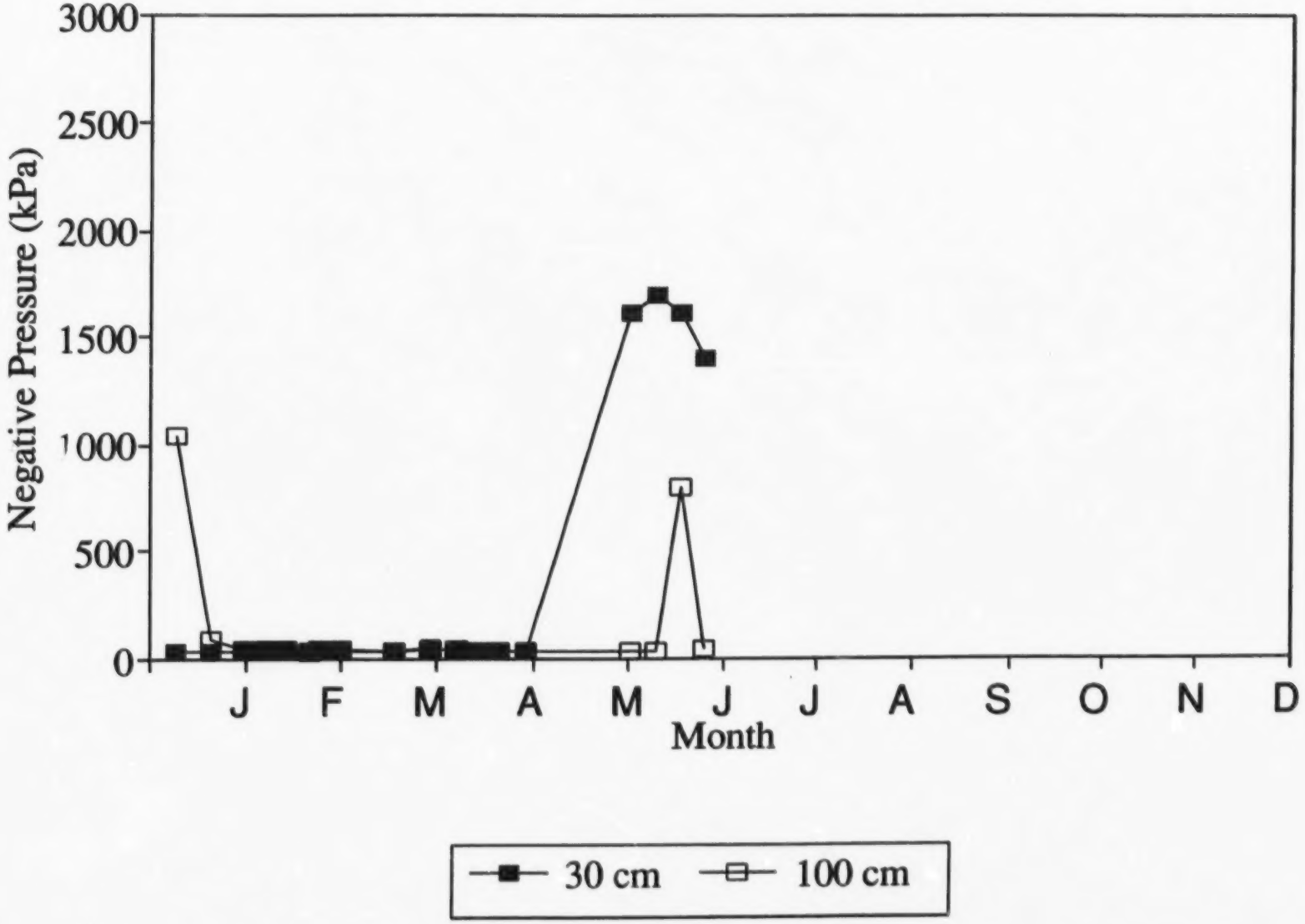


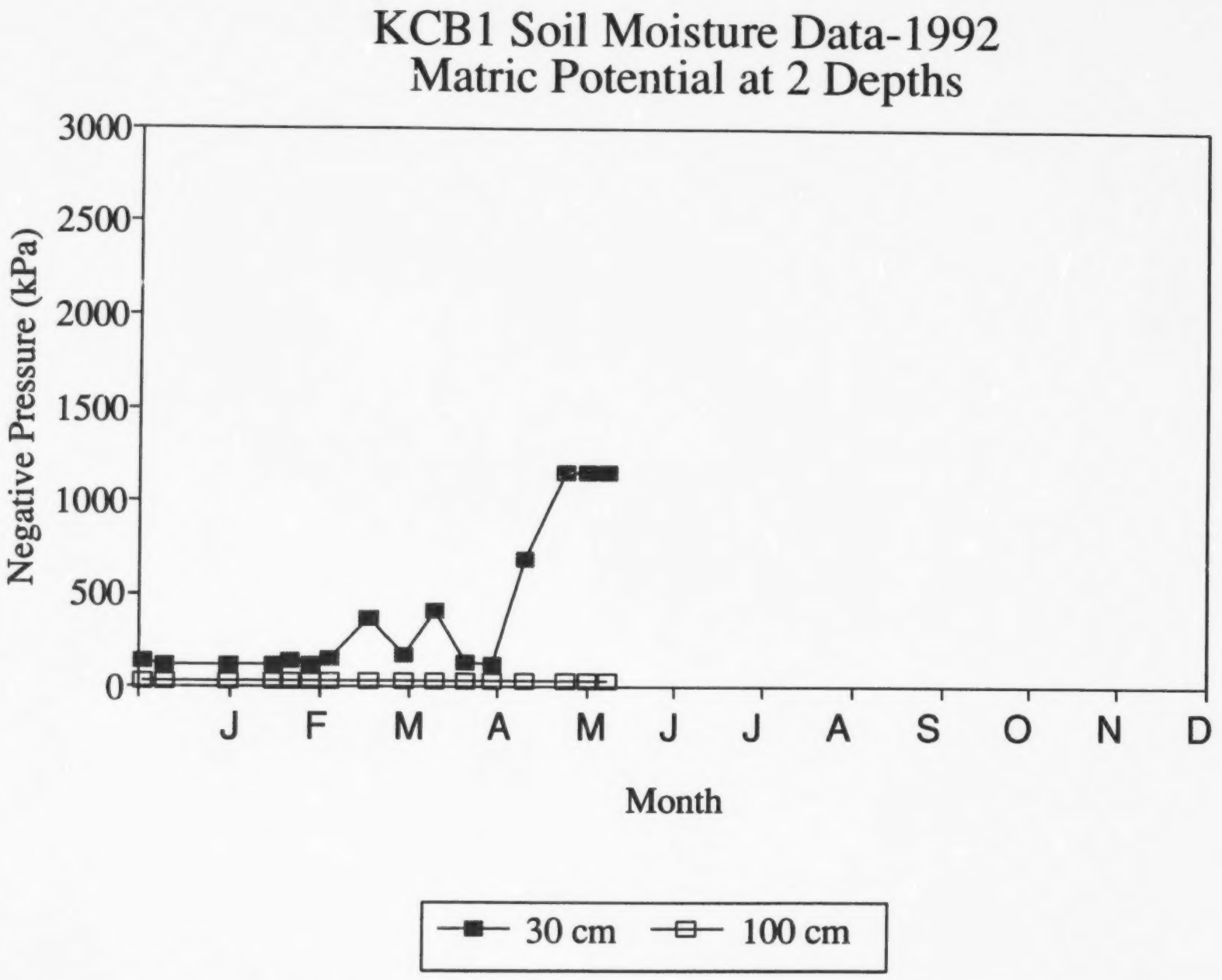

ECB1 Soil Moisture Data-1992
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

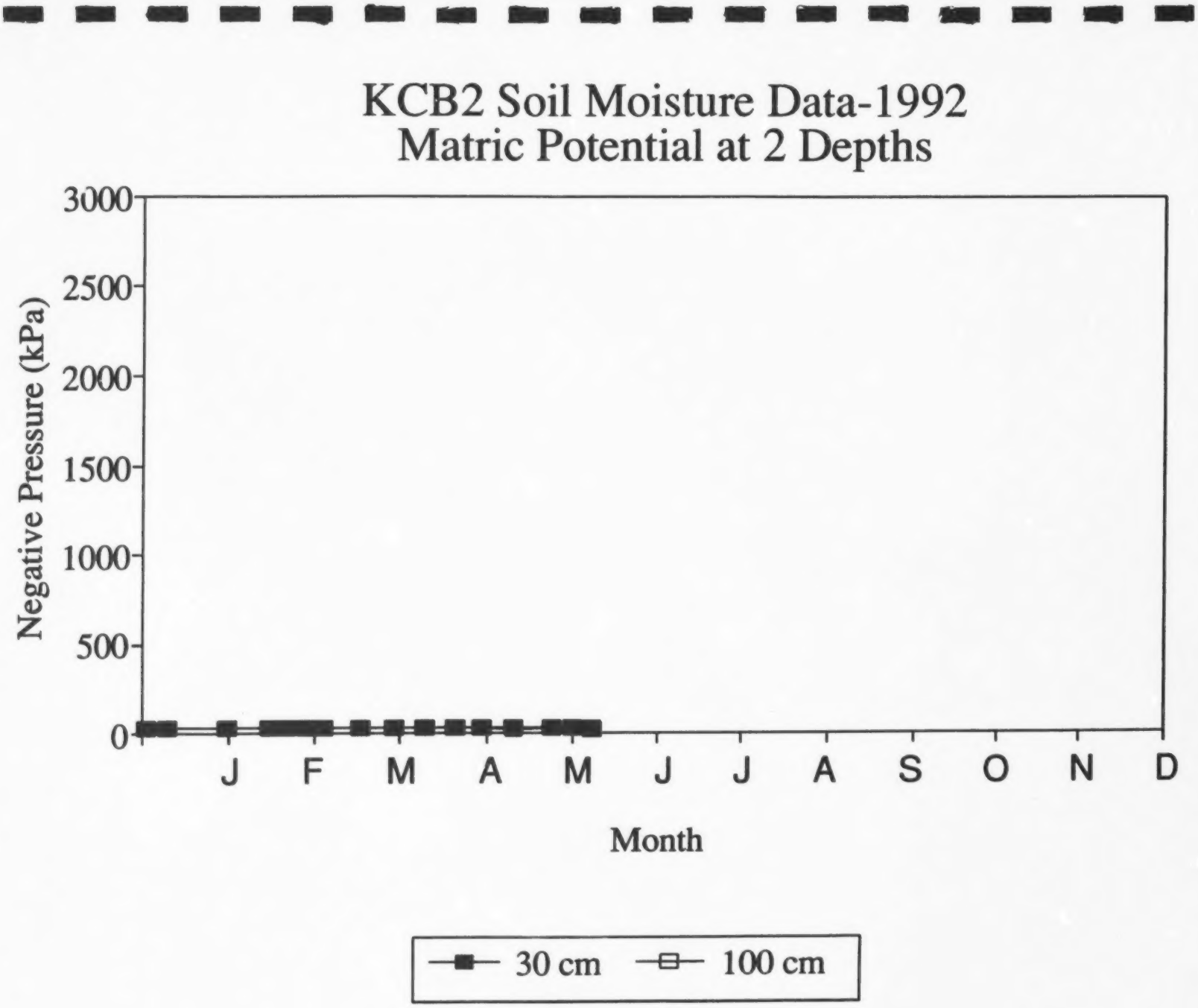

ECB2 Soil Moisture Data-1992
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

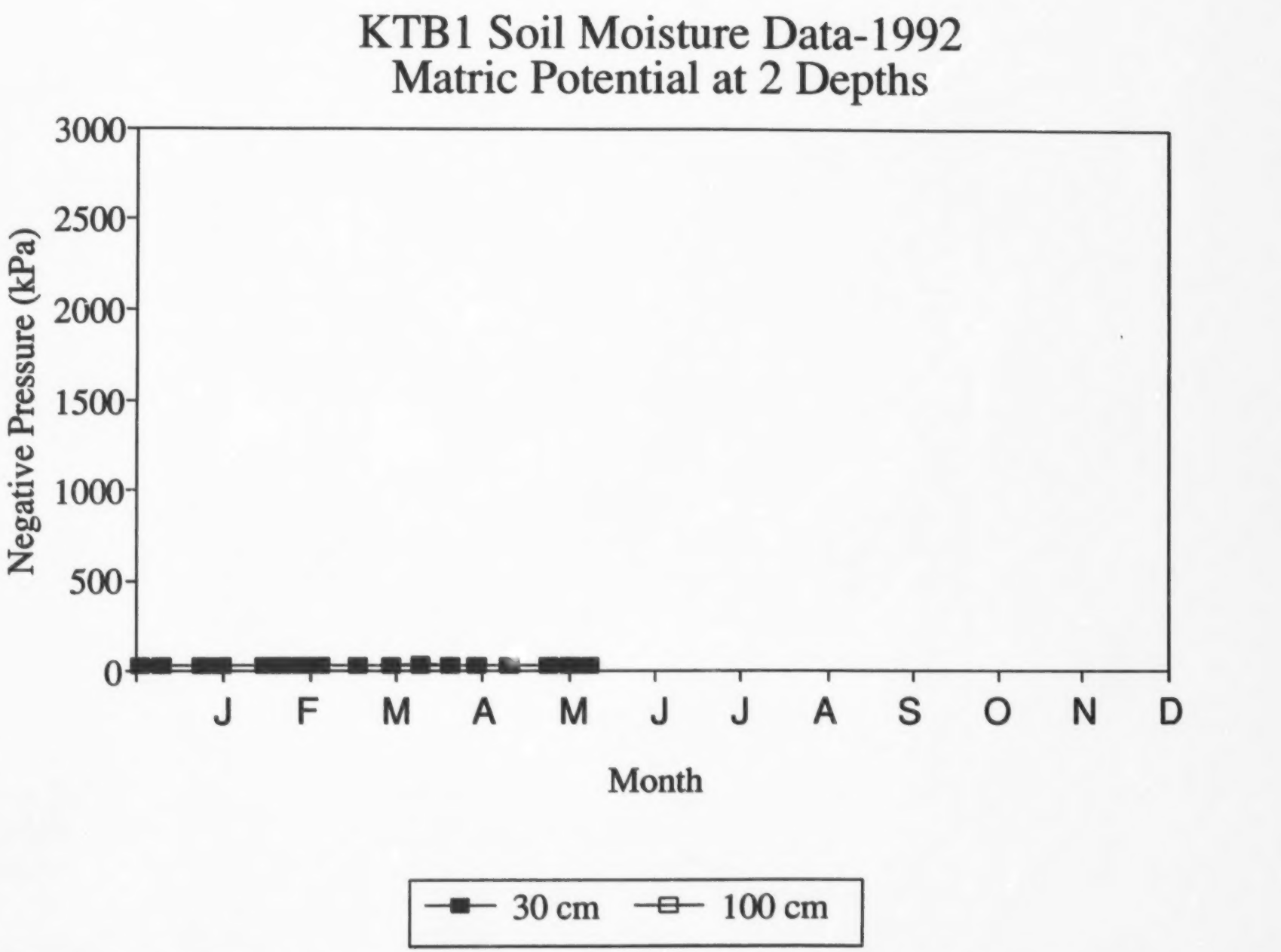

ETB1 Soil Moisture Data-1992
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

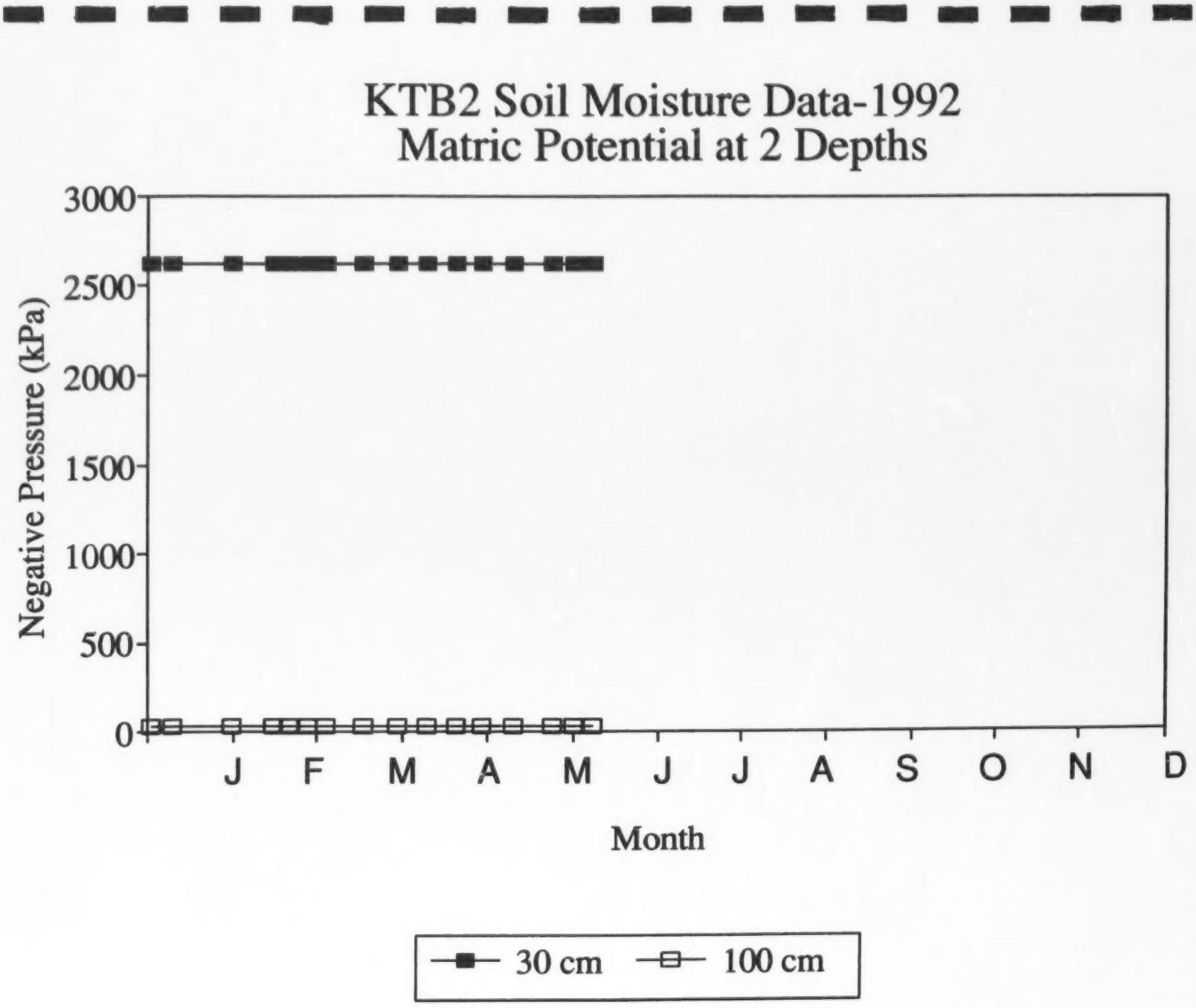
ETB2 Soil Moisture Data-1992
Matric Potential at 2 Depths



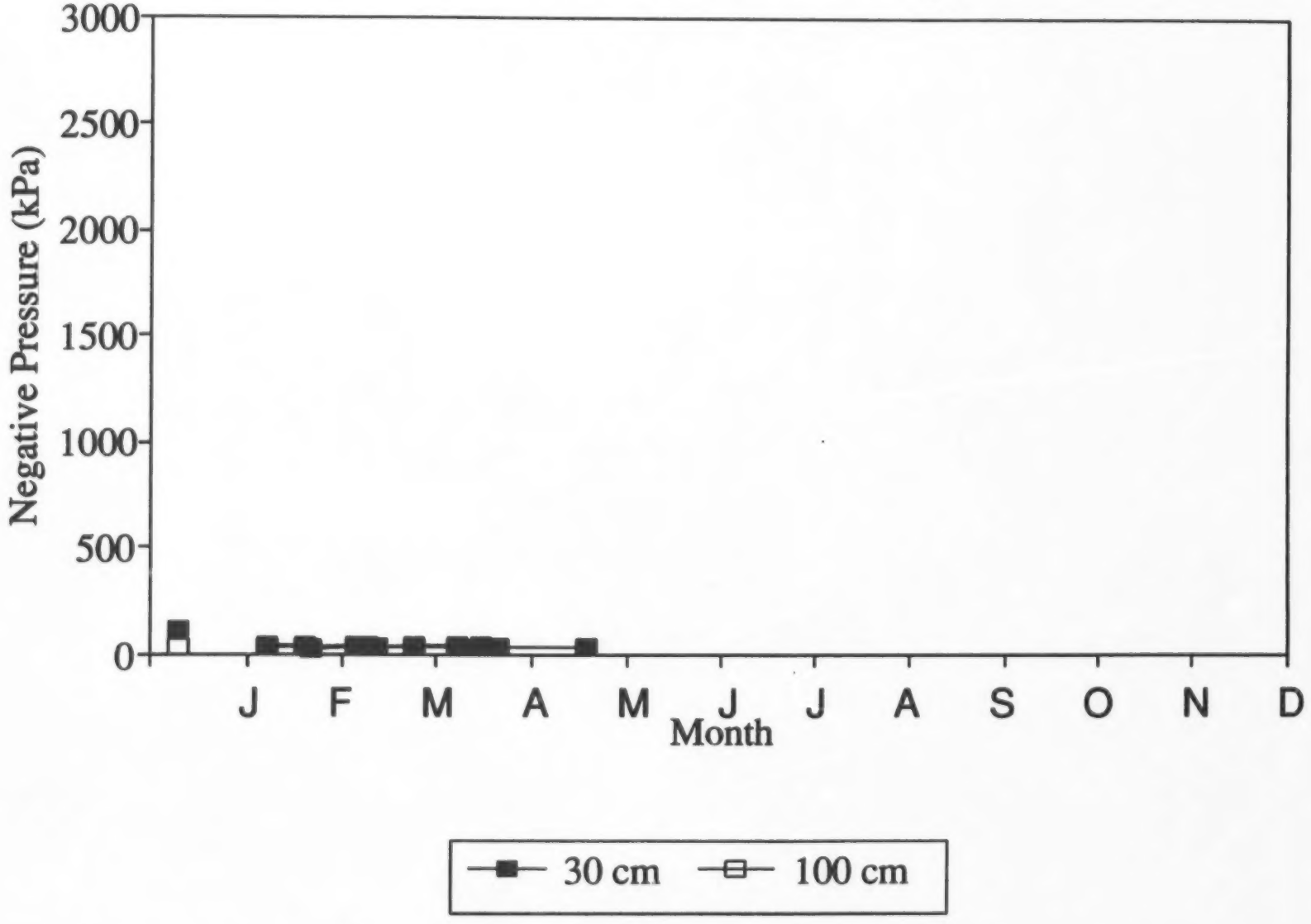

KCB1 Soil Moisture Data-1992
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm


KCB2 Soil Moisture Data-1992
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

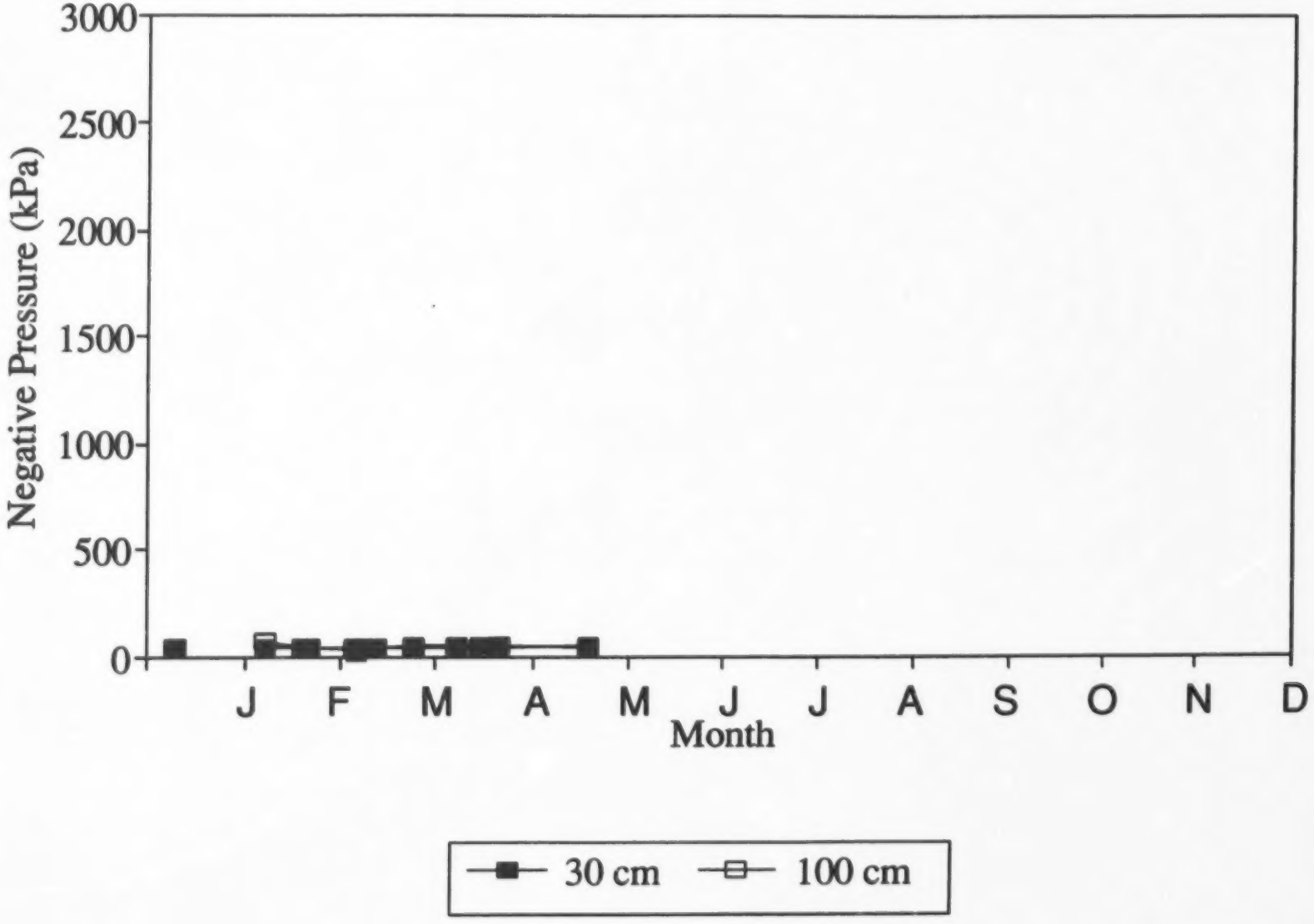

KTB1 Soil Moisture Data-1992
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm


KTB2 Soil Moisture Data-1992
Matric Potential at 2 Depths
Negative Pressure (kPa)
3000
2500
2000
1500
1000
500
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
30 cm
100 cm

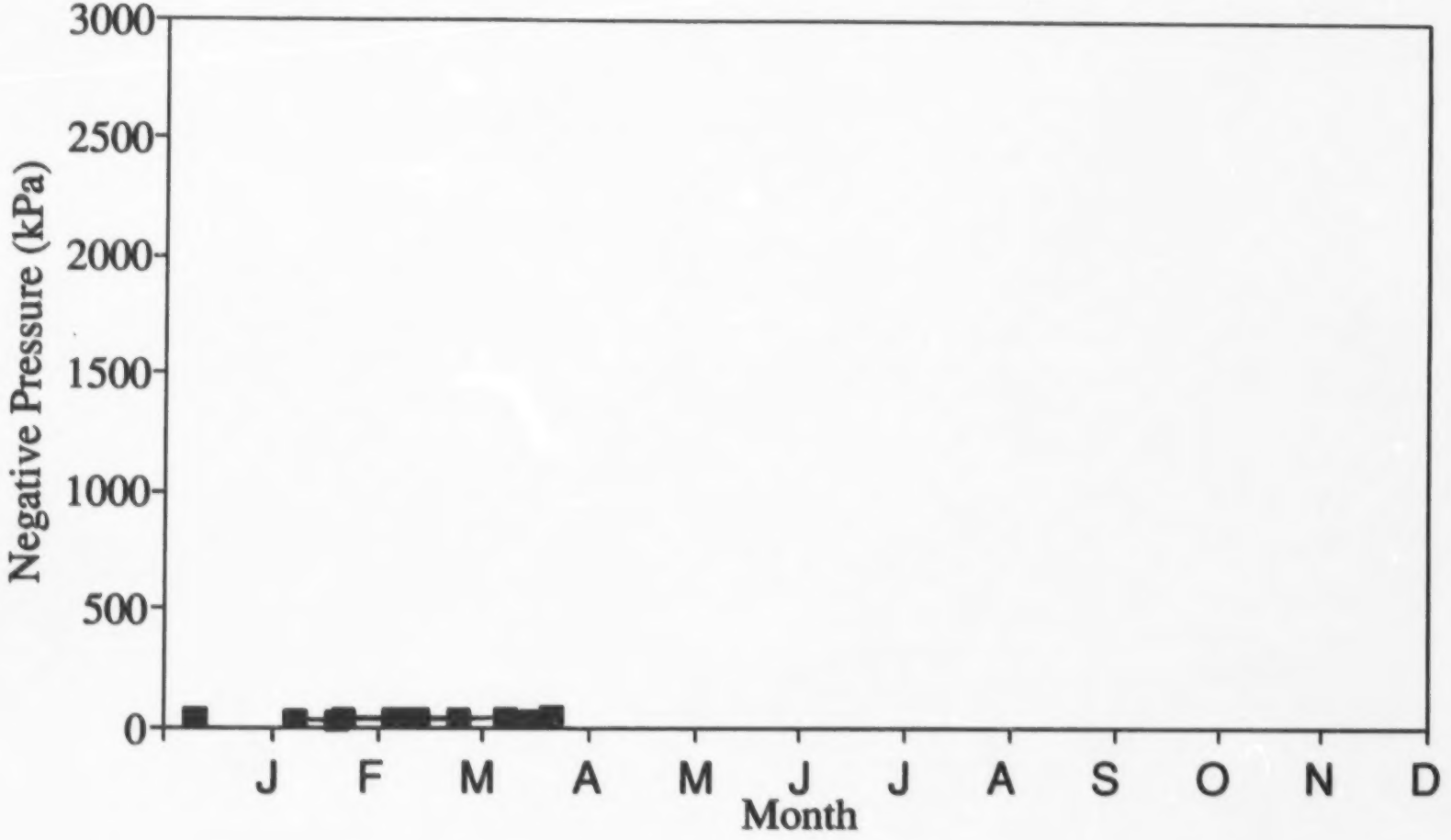
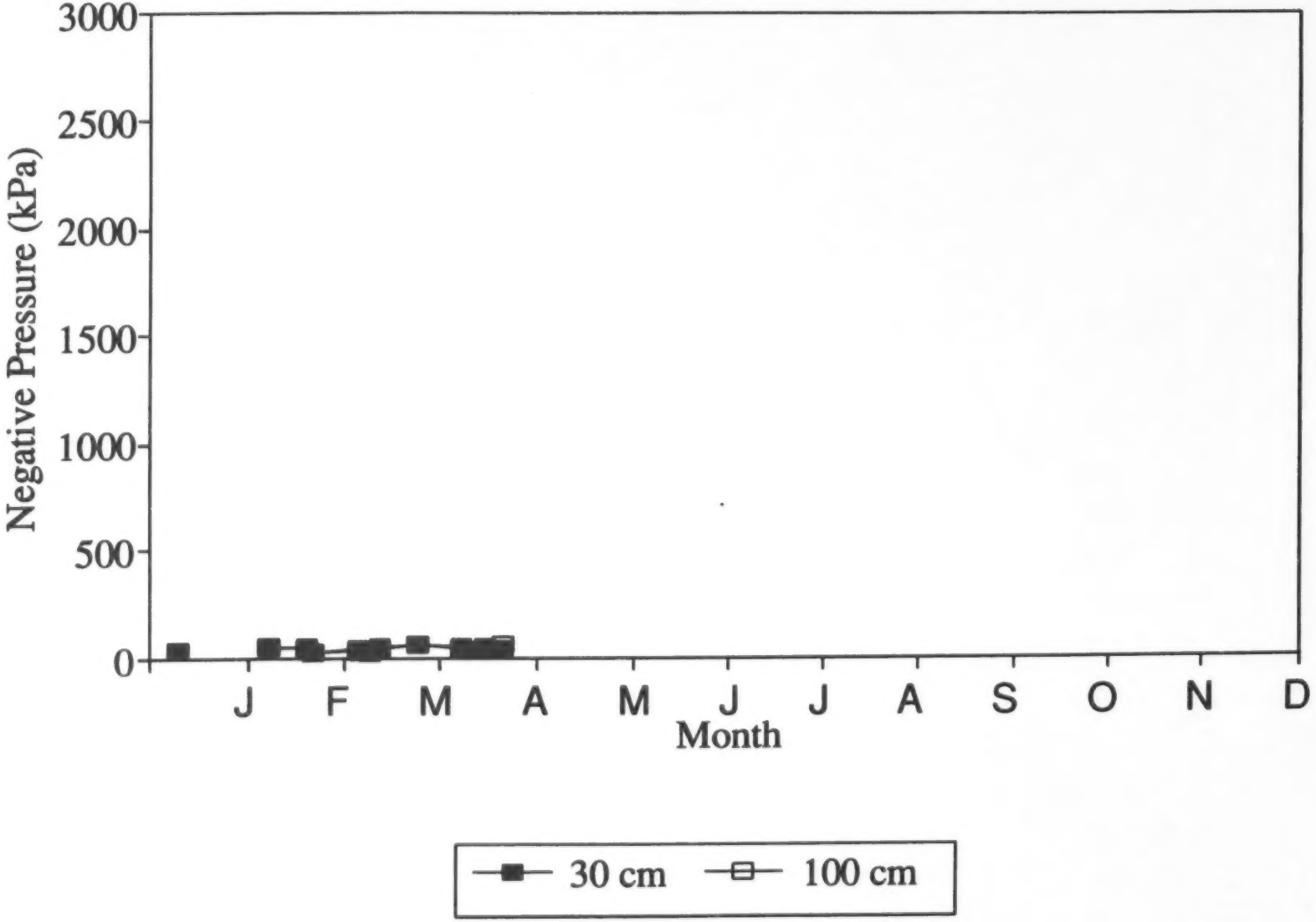
PCB1 Soil Moisture Data 1992
Matric Potential at 2 depths



PCB2 Soil Moisture Data 1992
Matric Potential at 2 depths



PTB1 Soil Moisture Data 1992
Matric Potential at 2 depths



PTB2 Soil Moisture Data 1992
Matric Potential at 2 depths